[illegible]

I. C. 7181

DECEMBER 1941

UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

INFORMATION CIRCULAR

STATUS OF SAFETY IN MINING

BY

D. HARRINGTON

AFTER THIS REPORT HAS SERVED YOUR PURPOSE AND IF YOU HAVE NO FURTHER NEED FOR IT, PLEASE RETURN IT TO THE BUREAU OF MINES, USING THE OFFICIAL MAILING LABEL ON THE INSIDE OF THE BACK COVER.

Generated on 2024-09-19 09:51 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

I.C. 7181,
December 1941.

INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

STATUS OF SAFETY IN MINING[1]

By D. Harrington[2]

INTRODUCTION

The mining industry of the United States has long been severely criticized because of its high rate of accident occurrence, not only as compared with other major industries in the United States but also with the mining industries of other countries, particularly Europe. Statistics (often not of a strictly comparable nature) indicate that the accident-frequency rate in all mining is currently about three times and the accident-severity rate is about seven times as great as the average for general industrial work in the United States. These figures are by no means comforting to humanitarian mining men, irrespective of their status in the industry, and they constitute a challenge that certainly cannot continue to be ignored much longer.

This picture becomes much darker when the above statistics are augmented with data indicating that on an exposure basis our mines (more particularly our coal mines) have accident rates two, three, or even more times as great as more or less similar types of mines in Europe, particularly England and Wales, Belgium, France, and Germany. However, these foreign accident statistics should be carefully analyzed before we become very much concerned about them, because they are not strictly comparable owing to several considerations, not the least of which is the fact that foreign methods of compiling or recording accident statistics often differ materially from ours. Moreover, foreign mining and other conditions are definitely dissimilar to ours in many if not most phases, and numerous other factors affect the comparability of foreign mine-accident statistics with ours. Unquestionably it should also be taken into consideration that the accident rate of the 130,000,000 or more constituting the populace of the United States as a whole is much higher than that of any other major country in the world and is two, three, or more times the rate of the European countries that have more favorable mine-accident rates than those of the United States. Moreover, it is significant that the mine-accident-severity rate of British mines is about six times the average accident-severity rate of the major industries of the British Isles, or but little more favorable than the comparable figures in the United States, namely, that mining has an accident-severity rate about seven times that of the average of about 30 of the major industries of this country.

1/ The Bureau of Mines will welcome reprinting of this paper provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 7181."
Presented at meeting of Am. Inst. Min. and Met. Eng., February 17-20, 1941, New York, N. Y.

2/ Chief, Health and Safety Branch, Bureau of Mines, Washington, D. C.

Generated on 2024-09-19 09:54 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Notwithstanding the fairly prevalent belief, fostered largely by the loose use and equally loose interpretation of accident statistics of foreign countries as compared with ours (frequently not even reasonably comparable), that the mines of the United States are conducted with less regard to safety than in other countries, there is good reason to believe that safety of the workers is given at least as much consideration in our mines as in the mines of any other nation, and that those who are employed in and around our mines enjoy safety conditions and procedures as well as results comparable with those achieved in any other country.

Notwithstanding the fact that in at least one branch of mining (bituminou coal) the year 1940 produced a relatively poor safety performance, on the whole the mining industry in all of its branches has for the past several years, in fact for about 3 decades, shown a slow but sure trend toward the better in safety of operation, as is indicated definitely in figures 1 and 2. Figure 1 shows that anthracite mining is doing at least a fairly good job in slowly but definitely reducing its fatality rate from 7.81 persons killed per million tons of coal produced in 1906 and 8.27 in 1907 to 4.1 in 1939 and 3.6 (tentative) in 1940, a reduction of more than 50 percent. Bituminous-coal mining reduced its fatality rate from 4.72 persons killed per million tons produced in 1906 and 6.46 in 1907 to 2.2 in 1939 and 2.7 (tentative) in 1940 - also a slow but steady decline of more than 50 percent. Figure 2 also shows that metal and nonmetallic-mineral mines have achieved definite even if somewhat slow progress in the reduction of fatal accidents, from 4.45 killed per thousand 300-day workers in 1911 to 2.00 (tentative) for 1939 (the latest available statistics) - again a reduction of more than 50 percent.

Table 1 gives the number killed in the coal and metal mines of the Unite States in the periods covered by figures 1 and 2 and indicates essentially the same slow but sure reduction in number of such deaths as is shown in figures 1 and 2.

During the 5-year period 1906-10, inclusive, 13,288 persons were killed in the coal mines of the United States - an average of 2,658 a year and a fatality rate of 5.89 persons killed per million tons of coal produced. The number killed in our coal mines in 1932 was 1,207, and the fatality rate per million tons of coal produced was 3.36; in 1933, 1,064 were killed - a rate of 2.78; in 1934 there were 1,222 deaths - a rate of 2.93; in 1935, there were 1,242 deaths - a rate of 2.93; in 1936 there were 1,342 fatalities - a rate of 2.73; in 1937 there were 1,413 fatalities - a rate of 2.83; in 1938 the death total was 1,105 - a rate of 2.79; and in 1939 it was 1,078 - a rate of 2.41, the lowest rate upon a tonnage basis in the history of coal mining in the United States. Tentative figures for 1940 indicate that 1,420 fatalities occurred, with a rate of 2.82, which was higher than in 1933, 193 1938, and 1939 but materially lower than was ever achieved before 1933.

Generated on 2024-09-19 09:51 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

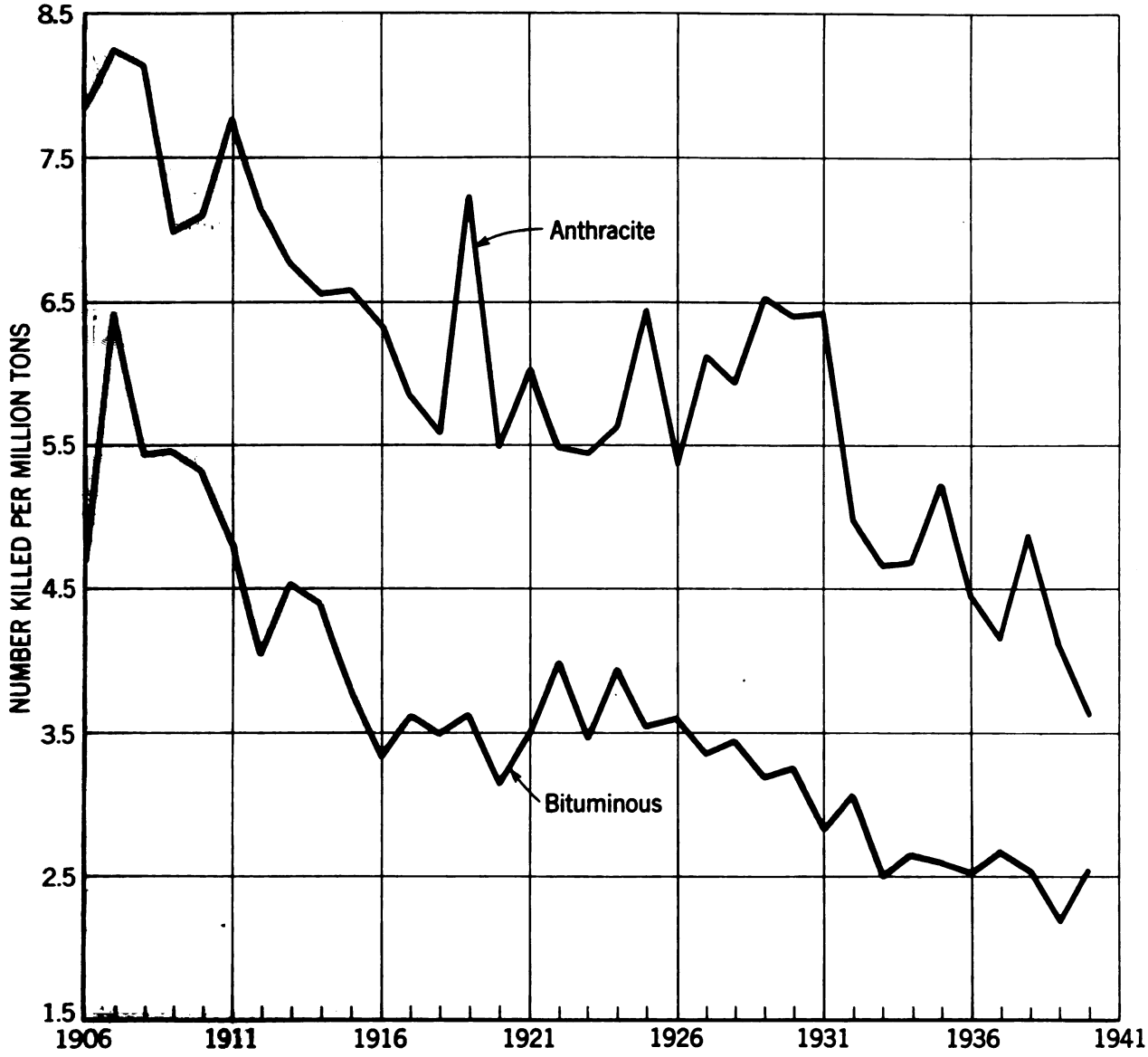

Figure 1.- Number of men killed per million tons of coal mined - all causes. Bituminous-coal and anthracite mines.

Generated on 2024-09-19 09:52 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

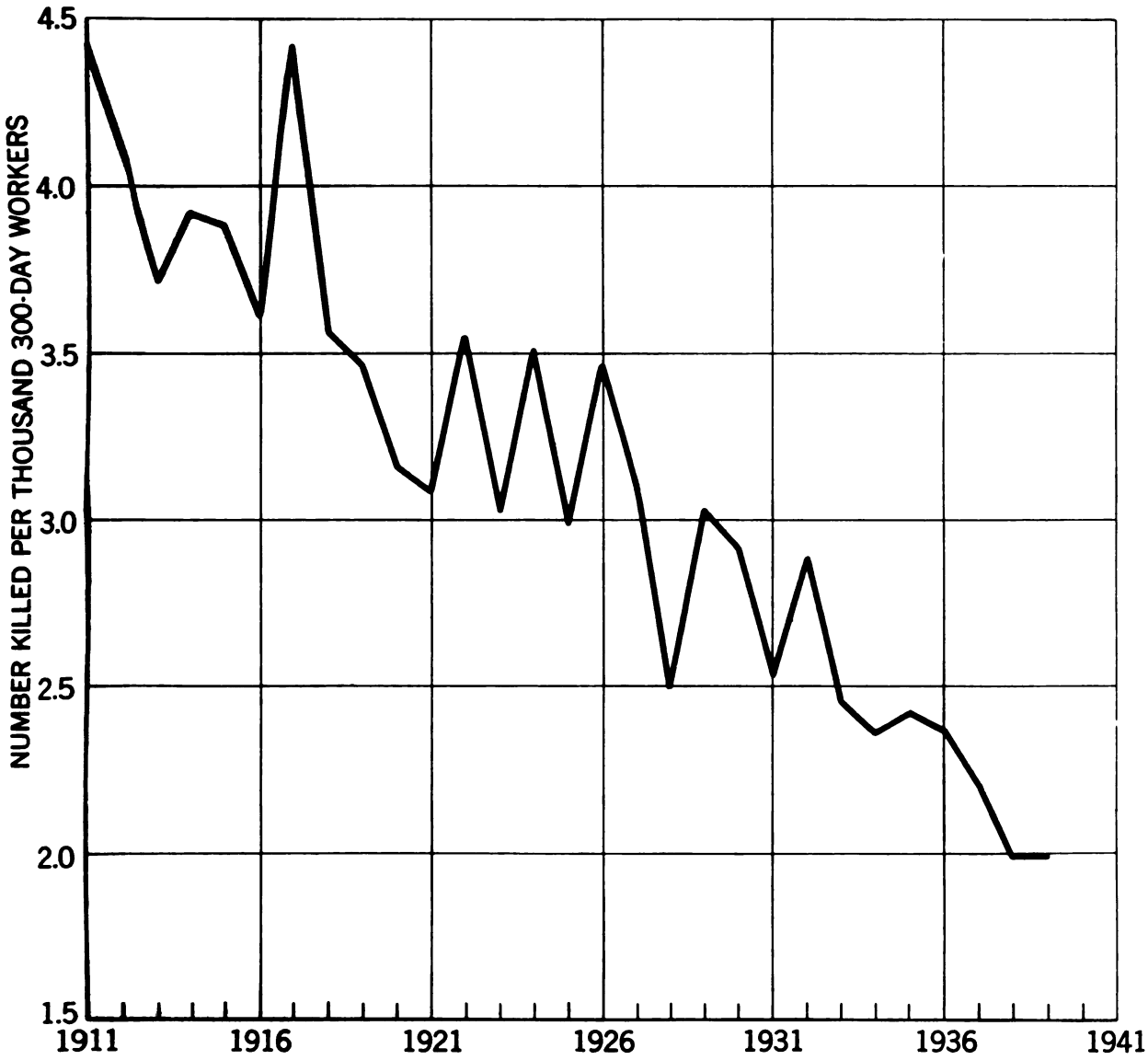

Figure 2.- Metal and nonmetallic-mineral mines. Number killed per thousand 300-day workers.

Generated on 2024-09-19 09:50 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 1. - Men killed in coal and metal mines in the United States

Year	Anthracite mines	Bituminous-coal mines	All coal mines	Metal mines
1906	557	1,581	2,138	----
1907	708	2,534	3,242	----
1908	678	1,767	2,445	----
1909	567	2,075	2,642	----
1910	601	2,220	2,821	----
1911	699	1,957	2,656	695
1912	601	1,818	2,419	661
1913	618	2,167	2,785	683
1914	595	1,859	2,454	559
1915	586	1,683	2,269	553
1916	555	1,671	2,226	697
1917	582	2,114	2,696	852
1918	551	2,029	2,580	646
1919	635	1,682	2,323	468
1920	491	1,780	2,272	425
1921	547	1,448	1,995	230
1922	300	1,684	1,984	344
1923	509	1,953	2,462	367
1924	496	1,906	2,402	418
1925	400	1,834	2,234	371
1926	453	2,065	2,518	430
1927	489	1,742	2,231	352
1928	447	1,729	2,176	273
1929	482	1,705	2,187	350
1930	444	1,619	2,063	271
1931	383	1,080	1,463	158
1932	249	958	1,207	107
1933	231	833	1,064	95
1934	268	958	1,226	116
1935	274	968	1,242	164
1936	244	1,098	1,342	199
1937	215	1,198	1,413	219
1938	225	880	1,105	156
1939	211	867	1,078	(1/)
1940	2/182	2/1,238	2/1,420	(1/)

1/ Not available.
2/ Estimate.

Generated on 2024-09-19 09:50 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

If the 5.89 fatality rate for the 5-year period 1906-10 had continued to the first of January 1941, the number of fatalities in coal mines of the United States would have been more than 32,000 greater than they actually were; hence, during the past 30 years the coal-mine-fatality rate has been reduced enough to indicate an average annual saving of life of more than 1,000 persons. Similar figures on prevention of nonfatal accidents are not available, but it is estimated that about 50 nonfatal accidents occur to 1 fatality; hence it may be assumed that about 50,000 nonfatal accidents have also been prevented annually. If the cost to the operator of a life is put into cold-blooded dollars and cents and a relatively low amount, such as $5,000, is taken as the "value" of a life, it will readily be seen that, irrespective of ethical or humanitarian considerations (and without consideration of nonfatal accidents), the annual saving of somewhat more than 1,000 lives may be considered as "worth" more than $5,000,000. If, in addition, it is conceded that as many as 50,000 nonfatal accidents have been prevented each year (and the assumption is by no means unreasonable), and the "cost" to the operator in compensation, hospitalization, etc., of a nonfatal accident is placed at $100 (some authorities estimate it at $300), it will be seen that at least an additional $5,000,000 annually has been saved to the coal industry through safer operation during the past 30 years.

Benefits to workers in and around coal mines as a result of this increased safety of operation are much more impressive than are those to the mine operators and the general public. Preventing the death of more than 32,000 coal-mine workers in the past 30 years has obviously also prevented a vast amount of suffering, pain, and misery of various kinds to the families of such workers; and the prevention of 50,000 or more nonfatal accidents annually for 30 years certainly has saved the miners, their families, their friends, and the community a large amount of pain, inconvenience, misery, and other penalties and losses.

The financial losses that the workers have avoided through this greater safety in coal-mine operation are in themselves colossal. The average age of the coal-mine worker who is killed is about 35 years, and in general he should, under normal conditions, have a future active working expectancy of <u>at least</u> 20 years. In normal times he should earn at least $1,000 annually, hence in his 20 years' active life expectancy he would receive approximately $20,000 for his services. Hence, the saving of the life of about 32,000 coal-mine workers in the past 30 years through decreased death rate in coal mining has prevented a financial loss to them of at least $640,000,000, and this does not consider the financial losses saved to the worker through the elimination of large numbers of nonfatal accidents. Hence, for the past 30 years an annual saving of more than $21,000,000 has been made to coal-mine workers in the prevention of fatalities.

Generated on 2024-09-19 10:07 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

COAL MINING

In 1939 the coal-mining industry achieved by far the best safety record in the recorded statistical history of the industry. As indicated in table 2, the fatality rate (tentative) for the coal mines of the United States reached the all-time low of 2.41 fatal accidents per million tons of coal produced, considerably lower than the figure of 2.73 reached in 1936, which was the lowest or best rate up to that time. The 2.41 rate for 1939, as well as the 2.82 rate for 1940, are estimates by W. W. Adams, Employment Statistics Section, Bureau of Mines, which were made sufficiently high to make it probable that belated information would not raise them, and it seems likely that both rates may ultimately be reduced. The 1939 rate was based upon an estimate of 1,078 fatalities in the production of approximately 448,131,000 tons of coal; the 1940 rate was based upon an estimate of 1,420 fatalities in the production of about 503,331,000 tons of coal. It will be noted from table 2 that in 1940 coal mining enjoyed its greatest tonnage since 1930 and suffered the greatest number of fatalities since 1931. The fatality rate of 1940 (2.82 fatalities per million tons of coal produced), while materially higher than in 1939, is lower than the rate in any other year except 1939 (2.41), 1936 (2.73), and 1933 (2.78); this is remarkable in view of the fact that there were 294 fatalities from gas and dust explosions in 1940 and only 46 in 1939, 57 in 1936, and 40 in 1933. If the fatalities due to explosions of gas and dust were eliminated from the record, the coal-mining fatality rate for 1940 would have been lower than that of 1939 or any other year in the recorded history of coal mining in the United States.

Although 1939 was not the best year in the history of coal mining in the United States insofar as explosion disasters are concerned, its record was far better than the average of either the relatively-recent or far-distant past. The disaster in a Kentucky coal mine in July 1939 was the only major explosion disaster during the year, equaling the banner year 1933 as to the number of major disasters even though 28 were killed in the 1939 disaster, whereas only 7 deaths resulted from the 1933 explosion.

Up to January 10, 1940, the bituminous-coal mines of the United States had the excellent record of only one major explosion disaster since April 22, 1938, or more than 20 months. The anthracite mines had an even better record, as they had not even one major disaster of any kind, including explosions, falls, haulage, etc., since June 2, 1938, or more than 19 months; anthracite mines at the writing of this paper (February 1, 1941) have had no major disasters in more than 2-1/2 years. This is a "far cry" from the record of 1907, with 18 major disasters causing 918 fatalities. In November 1939 a major disaster involving five fatalities from a fall of roof occurred in a wagon mine in Wyoming, this making two major disasters in 1939 from all causes, including explosions.

Table 3 shows that the 2 major disasters in 1939 (1 from an explosion and 1 from a roof fall) gave a total of 33 deaths from major disasters, a smaller number of major disasters and fatalities from major disasters in the coal mines of the United States than in any other year since 1905 except 1933, which had 1 with 7 fatalities, and 1934, which had 2 with 22 fatalities. Table 3 shows, too, that 1937, 1938, 1939, and 1940 had a much greater number of fatalities per major disaster than did any of the preceding 4 years (1933, 1934, 1935, and 1936) and also a much larger number killed in any single disaster.

Generated on 2024-09-19 09:53 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 2. - Fatalities and fatality rates per million tons of coal mined, 1906-1938, inclusive

Year	Fatalities (anthracite plus bituminous coal)	Deaths per million tons of coal produced	Tonnage (anthracite plus bituminous coal)
1906	2,138	5.27	405,955,888
1907	3,242	6.78	477,892,536
1908	2,445	5.97	409,309,857
1909	2,642	5.73	460,807,263
1910	2,821	5.62	501,596,378
1911	2,656	5.35	496,371,126
1912	2,419	4.53	534,466,580
1913	2,785	4.89	570,048,125
1914	2,454	4.78	513,525,477
1915	2,269	4.27	531,619,487
1916	2,226	3.77	590,098,175
1917	2,696	4.14	651,402,374
1918	2,580	3.80	678,211,904
1919	2,323	4.19	553,952,259
1920	2,272	3.45	658,264,932
1921	1,995	3.94	506,395,401
1922	1,984	4.16	476,951,121
1923	2,462	3.74	657,903,671
1924	2,402	4.20	571,613,400
1925	2,234	3.84	581,869,890
1926	2,518	3.83	657,804,437
1927	2,231	3.73	597,858,916
1928	2.176	3.78	576,093,039
1929	2,187	3.59	608,816,788
1930	2,063	3.84	536,911,136
1931	1,463	3.31	441,750,978
1932	1,207	3.36	359,565,093
1933	1,064	2.78	383,171,877
1934	1,222	2.93	416,536,313
1935	1,242	2.925	424,632,005
1936	1,342	2.73	491,138,762
1937	1,413	2.83	498,792,928
1938	1,105	2.79	1/395,696,632
1939	1,078	1/2.41	1/448,131,000
1940	1/1,420	1/2.82	1/503,331,000

1/ Tentative, as estimated 1940 by W. W. Adams, Employment Statistics Section, Bureau of Mines. These figures are likely to vary but slightly from the final figures, which will not be available for several months.

Generated on 2024-09-19 09:51 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 3. - Major disasters in coal mines of the United States, 1906-40, inclusive

Year	Major disasters	Fatalities	Fatalities per major disaster	Maximum fatalities in any 1 major disaster
1906	17	235	13.8	35
1907	18	918	51.0	361
1908	11	348	31.6	154
1909	19	498	26.2	259
1910	19	485	26.1	83
1911	15	413	27.5	128
1912	13	254	19.5	81
1913	8	464	58.0	263
1914	11	316	28.7	181
1915	11	262	23.8	112
1916	11	154	14.0	30
1917	9	262	29.1	121
1918	4	54	13.5	21
1919	9	201	22.3	92
1920	8	61	7.6	12
1921	5	34	6.8	11
1922	15	285	19.0	90
1923	11	301	27.4	120
1924	10	449	44.9	171
1925	14	270	19.3	53
1926	16	348	21.7	91
1927	9	162	18.0	97
1928	14	326	23.3	195
1929	7	151	21.6	61
1930	12	225	18.7	79
1931	6	56	9.3	28
1932	6	145	24.1	54
1933	1	7	7.0	7
1934	2	22	11.0	17
1935	4	35	8.7	13
1936	5	37	7.4	10
1937	6	101	16.8	34
1938	5	78	15.6	45
1939	2	33	16.5	23
1940	6	276	46	91

The years 1937, 1938, and 1939 show a bad trend in the severity of major coal-mine disasters, and this trend was much amplified and extended in 1940. All of the 6 major disasters of 1940, with a total of 276 fatalities, occurred in bituminous-coal mines as follows: Bartley mine, West Virginia, 91 fatalities in January; Willow Grove mine, Ohio, 72 in March; Sonman mine, Pennsylvania, 63 in July; Bates mine, Arkansas, 10 in August; Nelms mine, Ohio, 31 in November; and Raleigh No. 4 mine, West Virginia, 9 in December. Table 3 shows that 1940 had more fatalities from major explosion disasters than

Generated on 2024-09-19 09:51 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

any year since 1928, and that the number of fatalities per major disaster (46) is the highest since 1906, except in 1913, when the average fatalities per major disaster was 58, and in 1907, when the average was 51.

All of the relatively severe explosion disasters of the 3 years, 1937, 1938, and 1939 (as well as 5 of the 6 in 1940) have taken place in highly-mechanized mines; at least 5 of these bad disasters in the past 4 years have been on night shifts, and at least 4 of the explosions have been associated with blasting during the working shift. The fact that nearly all of the worst coal-mine-explosion disasters of the past 4 years have been in mechanized-loading (or so-called highly mechanized) mines is significant; in 1940, of 276 fatalities from major coal-mine-explosion disasters 213, or more than three-fourths, occurred in highly mechanized mines, which produce less than one-third of the country's coal. It is significant that none of the major explosions in the past 4 years have occurred in mechanized mines of Wyoming and Illinois, where mechanized loading got its earliest foothold and where by far the largest proportion of the output comes from such mines. This may be interpreted as indicating that the operators of such mines in those States realize the possible hazards of the system and have taken precautions against the occurrence of major explosion disasters by adopting safe ventilation, blasting, and ignition practices as well as handling the dust hazard by proper use of wetting methods and rock dusting. In other words, it seems evident that major disasters need not occur in mechanized mines if readily available prevention procedures are put in use and kept in effect.

Table 4 contains data on major disasters in coal mines from 1931 to 1940, inclusive; one such disaster in 1934, one in 1935, and one in 1936 was a mine fire; one in 1935 was a cage accident; and one in 1939 was a roof fall rather than an explosion. As shown, the 19 major disasters in 1937-40, inclusive, were initiated as follows: Electricity 7, open light or smoking 7, blasting 4 (the gas in one of the open-light ignitions was released by blasting), roof fall 1. It will be noted that the last major disaster in an anthracite mine occurred on June 2, 1938, or considerably more than 2 1/2 years ago, giving the anthracite industry an unusually fine record in this respect. It is also evident that from the occurrence of the Keen Mountain mine disaster on April 22, 1938, to the Duvin mine disaster on July 14, 1939 the bituminous mines of the United States were free of major disasters for nearly 15 months, which also was a good record.

Generated on 2024-09-19 10:20 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 4. - Major coal-mine disasters, 1931-1940, inclusive

Date	Mine	Location	Nature of accident	Killed
1931 Jan. 3	Midvale No. 4	Midvale, Ohio	Explosion.	5
1931 Jan. 6	No. 2	Beckley, W. Va.	do.	8
1931 Jan. 28	Little Betty	Bugger, Ind.	do.	28
1931 May 29	Richard Colliery	Mount Carmel, Pa.	do.	5
1931 Nov. 3	No. 20	Holden, W. Va.	do.	5
1931 Dec. 28	Overton No. 1	Irondale, Ala.	do.	5
1932 Jan. 18	Parrott	Parrott, Va.	Explosion.	6
1932 Feb. 27	Boissevain	Boissevain, Va.	do.	38
1932 June 13	Splashdam No. 6	Splashdam, Va.	do.	10
1932 Dec. 7	Jones	Madrid, N. Mex.	do.	14
1932 Dec. 9	Zero	Yancey, Ky.	do.	23
1932 Dec. 23	Shafer	Moweaqua, Ill.	do.	54
1933 Sept. 11	Oakmont	Barking, Pa.	Explosion.	7
1934 Mar. 12	No. 10	Wheatcroft, Ky.	Asphyxiation.	5
1934 Aug. 6	Derby No. 3	Big Stone Gap, Va.	Explosion.	17
1935 Jan. 21	Gilberton	Gilberton, Pa.	Explosion.	13
1935 May 7	South Wilkes-Barre	Wilkes-Barre, Pa.	Rock fell down shaft and struck ascending cage.	7
1935 May 11	Barrackville	Barrackville, W. Va.	Fire in hoisting shaft.	6
1935 July 17	No. 5	Van Lear, Ky.	Explosion.	9
1936 Jan. 30	Monarch No. 2	Broomfield, Colo.	Explosion, electrical.	8
1936 Aug. 1	Kathleen	Dowell, Ill.	Mine fire, electrical.	9
1936 Aug. 24	Clear Spring	W. Pittston, Pa.	Explosion, electrical.	5
1936 Sept. 2	Macbeth	Logan, W. Va.	do.	10
1936 Nov. 19	No. 1	Bates, Ark.	do.	5
1937 Mar. 11	Macbeth	Logan, W. Va.	Explosion, electrical.	18
1937 Mar. 28	Kramer	Stump Creek, Pa.	do.	9
1937 June 21	Rupert (Keystone)	Keystone, Ohio	Powder explosion, open light.	6
1937 July 15	Baker	Sullivan, Ind.	Explosion, open light.	20
1937 Oct. 15	Mulga	Birmingham, Ala.	Explosion, blasting.	34
1937 Oct. 26	Jonesville	Jonesville, Alaska	Explosion, open light.	14
1938 Jan. 12	Harwick	Harwick, Pa.	Explosion, electrical.	10
1938 Feb. 11	Vail Mine	Star Valley, Wyo.	Explosion, blasting.	5
1938 Apr. 22	Keen Mountain	Hangar, Va.	do.	45
1938 Apr. 27	St. Clair	St. Clair, Pa.	Explosion, open light.	8
1938 June 2	Butler Colliery	Pittston, Pa.	Explosion.	10
1939 July 14	Duvin	Providence, Ky.	Explosion, blasting.	28
1939 Nov. 9	Muddy Creek	Muddy Creek, Wyo.	Roof fall.	5
1940 Jan. 10	No. 1	Bartley, W. Va.	Explosion, probably electrical.	91
1940 Mar. 16	Willow Grove	Neffs, Ohio	Explosion, blasting.	72
1940 July 15	Sonman	Sonman, Pa.	Explosion, electrical.	63
1940 Aug. 27	Bates	Bates, Ark.	do.	10
1940 Nov. 29	Nelms	Nelms, Ohio	do.	31
1940 Dec. 17	Raleigh No. 4	Raleigh, W. Va.	Explosion, smoking.	9

Generated on 2024-09-19 09:50 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Table 5 shows the fatality rate per million tons of coal from the underground bituminous-coal mines of the United States from 1931 to 1940 (11 months), divided into those due to major explosions and those due to all other causes of fatal accidents in and around underground coal mines, as well as the percentage of total fatalities due to major disasters. This tabulation indicates how badly the major disasters of 1940 influenced the over-all fatality rate of the bituminous-coal mines of the United States. The percentage of the fatality rate of underground coal mines of the United States chargeable to major disasters for the first 11 months of 1940 was 26.0; the similar percentage for 1933 was only 0.9; for 1935 it was 1.0, and for 1936 it was 2.2; for 1939 it was 3.4. When it is realized that in 1940 about one-fourth of the fatality rate of underground bituminous-coal mines was caused by major explosions, the extreme importance of doing everything possible to avoid these disasters is readily realized. This is made even more evident when the cost of these disasters is considered. In addition to the loss of 276 lives and the injury to scores of others, with the myriads of miseries of various kinds inflicted on many people, the dollars and cents expenditures necessitated by the 6 major disasters of 1940 amounted to several millions of dollars, or almost enough to maintain adequate rock dusting in all of the coal mines of the United States.

TABLE 5. - Underground bituminous-coal mines in the United States,1/ 1931-40, inclusive

Year	Fatality rate per million tons due to major explosions	Fatality rate per million tons due to all other causes underground	Percentage of all causes underground due to major explosions
1931	0.14	2.68	5.0
1932	.50	2.59	16.2
1933	.02	2.43	.9
1934	.05	2.59	1.9
1935	.03	2.57	1.0
1936	.06	2.47	2.2
1937	.23	2.49	8.4
1938	.19	2.39	7.3
1939	.08	2.19	3.4
2/1940	.71	2.02	26.0

1/ Underground only; open-pit excluded.
2/ 11 months. Figures subject to revision.

Table 6 gives some data on rock dusting taken from Bureau of Mines Report of Investigations 3543, by W. W. Adams, which gives the latest available national data on the use of rock dust. It will be noted that only 7 to 8 percent of the coal mines of the United States (400 to 500 of the approximate 6,000 coal mines in the United States) make any claim to using rock dust, and a very fair assumption is that not even 1 percent are at all adequately rock-dusted. This is a sad commentary on the attitude of by far the majority of the membership of the coal-mining industry toward trying to safeguard not only the lives of the workers but also the property of the company, as adequa rock-dusting can be maintained in almost any coal mine in the United States for 1 to 2 cents per ton of coal produced.

Generated on 2024-09-19 09:59 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 6. - Summary of data for underground bituminous-coal mines in the United States using rock dust, 1930-38

Year	Mines using rock dust	Production from mines using rock dust, short tons	Percentage of all underground mines using rock dust	Percentage of total underground production from mines using rock dust	Rock dust used, pounds
1930	474	148,634,912	8.4	33.2	137,738,000
1931	449	115,904,819	8.3	31.9	119,621,000
1932	393	88,632,327	7.5	30.6	74,938,000
1933	382	96,691,753	7.2	30.7	73,150,000
1934	407	112,455,110	6.8	33.2	103,234,000
1935	416	119,368,116	7.0	34.2	109,988,000
1936	460	161,039,698	7.4	39.3	142,818,000
1937	518	177,389,078	8.5	42.7	173,190,000
1938	431	126,635,677	7.2	39.7	144,430,000

Table 7 also was taken from Report of Investigations 3543, Use of Rock Dust in Bituminous Mines 1930-38, by W. W. Adams. It appears that Wyoming, Alabama, Utah, and New Mexico have the most effectively rock-dusted mines, though the amount of rock dust used per ton of coal produced in Wyoming seems somewhat inadequate. Alabama seems to have had the most complete protection from rock dust in 1938; this may be due to the fact that the Mulga (Ala.) disaster of October 1937 undoubtedly had the effect of greatly stimulating the use of rock dust in Alabama's coal mines in 1938.

TABLE 7. - Rock dusting in 1938 in various States

States	Percentage of total underground employees in bituminous mines using rock dust	Percentage of State underground tonnage of bituminous coal from mines using rock dust	Percentage of State's man-hours worked in underground bituminous coal mines using rock dust	Rock dust used per ton of coal produced by underground bituminous-coal mines using rock dust, pounds
Wyoming	77.8	74.9	77.2	0.57
Alabama	70.6	77.6	71.8	2.43
Utah	70.2	86.2	81.4	.94
New Mexico ..	58.1	60.5	59.9	1.61
Washington ..	54.5	61.5	54.0	.28
West Virginia	45.5	52.7	50.3	1.50
Pennsylvania. (Bituminous)	42.2	45.8	43.4	.96
Indiana	38.9	51.5	38.9	.35
United States	33.2	39.7	35.8	1.14
Colorado.....	22.1	20.5	20.0	.81
Illinois	19.0	29.8	20.7	.35
Kentucky	14.5	14.0	13.7	.33
Ohio	10.0	16.6	13.0	.19

Generated on 2024-09-19 09:56 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Table 8, taken in part from Bureau of Mines, Coal Mine Fatalities 112, December 1940, includes some decidely interesting information about thickness of coal and accident occurrence in the coal mines of the United States. It will be noticed that in 1938 a total of 6,016 underground bituminous-coal mines are known to have operated in the United States, to have produced 319,242,392 tons of coal, employed 373,271 men, and had 823 fatal accidents. Of these, 2,546 had coal beds 48 inches or less in thickness; these mines produced a little more than 102,000,000 tons of coal with the labor of about 138,000 men and had 293 fatal accidents.

1,477 mines operated in beds 49 to 72 inches in thickness, produced a little more than 106,000,000 tons of coal with the labor of a little over 126,000 men, and had 279 fatalities.

723 mines worked in beds more than 72 inches in thickness, produced a little over 93,000,000 tons of coal with the labor of not quite 84,000 men, and had 165 fatalities. The thickness of the coal bed was not ascertained for 1,270 mines that produced slightly less than 18,000,000 tons of coal, had 86 fatalities, and employed 24,727 men.

This tabulation indicates that underground bituminous-coal mines with coal veins 49 to 60 inches in thickness have the worst fatal-accident rate upon an exposure basis (2.16 fatalities per million man-hours), mines having beds 73 to 84 inches in thickness being next (2.01 killed per million man-hours). On the other hand, mines with coal 13 to 24 inches in thickness have the best fatality rate upon an exposure basis (1.19 killed per million man-hours of exposure).

The tabulation also indicates that the worst nonfatal-injury rate is made in mines with coal 37 to 48 inches thick (89.04 injured per million man-hours); and, again, the thin-bed mines (13 to 24 inches) have the low rate (42.56 injured per million hours). In general, it would appear that relatively coal mines with thin beds have accident rates lower than mines with relatively thick beds.

Generated on 2024-09-19 10:00 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:56 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 8. - Accidents and employment underground at bituminous-coal mines in the United States, classified according to thickness of coal seam being mined, 1938

Thickness of coal seam, inches	Mines	Production, short tons	Men employed	Men killed	Men injured	Average number of employees per mine	Tons per man-hour of employment	Rate per million man-hours	
								Killed	Injured
13-24.....	215	2,046,123	5,620	7	250	26	0.349	1.19	42.58
25-36.....	965	19,255,341	32,667	65	2,751	34	.509	1.72	72.76
37-48.....	1,366	80,306,715	100,339	221	10,400	73	.688	1.89	89.04
49-60.....	862	59,948,561	69,148	165	6,049	80	.787	2.16	79.37
61-72.....	615	46,729,547	56,991	114	5,329	93	.766	1.87	87.30
73-84.....	324	45,179,794	41,716	94	3,661	129	.965	2.01	78.22
85 + ...	399	48,010,031	42,063	71	3,755	105	1.034	1.53	80.89
Not stated.....	1,270	17,766,280	24,727	86	1,497	19	.673	3.26	56.73
Total underground	6,016	319,242,392	373,271	823	33,692	62	.765	1.97	80.73

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 9. - Coal-mining fatalities and fatality rates and tonnage, 1931-40, inclusive

Year	Fatalities (anthracite plus bituminous)	Deaths per million man-hours of exposure	Deaths per million tons of coal produced	Tonnage (anthracite plus bituminous)
1931	1,463	1.819	3.31	441,750,978
1932	1,207	1.897	3.36	359,565,093
1933	1,064	1.480	2.78	383,171,877
1934	1,222	1.593	2.93	416,536,313
1935	1,242	1.695	2.925	424,632,005
1936	1,342	1.624	2.73	491,138,762
1937	1,413	1.741	2.83	498,792,928
1938	1,105	1.779	2.79	1/395,696,632
1939	1,078	1.589	1/2.41	1/448,131,000
1940	1/1,420	1/1.879	1/2.82	1/503,331,000

1/ Tentative, as estimated 1941 by W. W. Adams, Employment Statistics Section, Bureau of Mines. These figures are likely to vary but slightly from the final figures, which will not be available for several months.

This tabulation gives information on fatalities, fatality rates, and tonnages for the coal mines of the United States from 1931 to 1940, inclusive It will be noted that coal production in 1940 was materially higher than in 1939; in fact, it was higher than in any other year since 1930, when 536,911, tons were produced. Upon the basis of fatalities per million man-hours of exposure 1940 had a poorer record with a higher rate (1.879, tentative) than any other year listed in table 2 except 1932, when the rate was 1.897. From the viewpoint of fatalities per million tons of coal produced, the tentative rate of 2.82 fatalities per million tons of coal produced was higher than in 1933, 1936, 1938, and 1939, but it was much lower than in any year before 19

Table 10, which gives coal-mining-fatality rates per million man-hours of exposure for 1931 - 1940, inclusive, broken down according to main causes of accidents, gives some food for thought in connection with what occurred in 1940, as well as trends for the past several years. It is noticeable that in 1940 the fatality rate resulting from falls of roof and coal (constituting ordinarily about or more than half of the fatalities in our coal mines) had a lower rate (1.025 fatalities per million man-hours) of occurrence than in any other recent year except 1933, when the rate was 0.979. This fact is encouraging because the prevention of fatalities from falls of roof and coal has always constituted one of the most difficult problems confronting those engaged in the production of coal. The haulage rate of 0.373 fatality per million man-hours in 1940 was higher than usual, being exceeded in the last 9 years only by the rate of 0.413 in 1937 and 0.380 in 1935. Unquestionably much of this increase in the mine-haulage hazard is due to practices connect with some of the new mechanized-mining systems.

Generated on 2024-09-19 09:50 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 10. - Fatality rates per million man-hours of exposure at all coal mines in the United States, 1931-40

Year	Underground 1/							Underground, open pit, and surface 2/
	Falls of roof and coal	Haulage	Explosions	Explosives	Machinery	Electricity	Others	
1931	1.280	0.354	0.131	0.060	0.033	0.097	0.134	1.819
1932	1.198	.342	.323	.069	.053	.090	.084	1.897
1933	.979	.329	.068	.058	.042	.090	.090	1.480
1934	1.092	.312	.082	.057	.049	.089	.113	1.593
1935	1.106	.380	.082	.083	.058	.075	.122	1.695
1936	1.102	.338	.084	.076	.056	.077	.127	1.624
1937	1.089	.413	.174	.068	.057	.084	.093	1.741
1938	1.195	.327	.206	.067	.054	.079	.109	1.779
1939	1.129	.331	.084	.058	.069	.093	.080	1.589
1940 3/	1.025	.373	.456	.061	.047	.066	.080	1.879

1/ Rates computed on man-hours worked underground.
2/ Rates computed on total man-hours.
3/ Preliminary figures.

Table 10 indicates the very vital effect of the mine disasters of 1940 on the accident rates; the rate of 0.456 due to explosions is by far the highest experienced in the period 1931 - 40, inclusive. If the explosion rate were eliminated from the 1940 record, the coal mines of the United States would have had one of the lowest fatal-accident rates in the present century. This again shows the very great necessity of eliminating or at least very greatly reducing the occurrence of mine disasters, and by the use of readily available procedures (ventilation, watering, rock-dusting, permissible devices, and equipment) there is absolutely no reason why widespread mine explosions cannot be eliminated or at any rate their occurrence very greatly reduced.

The coal-mining-fatality rates (tentative), upon an exposure basis, in connection with accidents from explosives (0.061) and machinery (0.047) are slightly lower than the average for the past 10 years; however, the explosives fatality rate does not include fatalities from explosion disasters initiated by explosives, one of the worst disasters of the year having been caused by on-shift blasting with a hazardous type of explosive. The fatality rate from accidents due to electricity was materially lower than the average for the past 10 years, but again this does not include fatalities from mine disasters initiated by electricity, there having been four major disasters (with 195 fatalities) caused by electric arcs. The 1940 coal-mining-fatality rate (0.080 tentative) from miscellaneous or "other" causes, including fatalities that occurred in shafts or on the surface or in open-pit mines, is about 25 percent lower than the average for the 10-year period for similar causes.

The fatality rate in 1940 (tentative) per million man-hours of exposure for all causes of coal-mining accidents (1.879) is materially higher than the rate of 1.589 for 1939. However, if the rate for explosions is eliminated from both 1939 and 1940, the rate for 1940 would be 1.423 and that for 1939 would be 1.505; hence,

Generated on 2024-09-19 10:22 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

if it had not been for the very bad record in mine explosions in 1940 that year would have had a more than ordinarily favorable fatality rate and record. The fatality rate upon an exposure basis was higher than in any year in the past decade except 1932 when the rate was 1.897.

Unquestionably much of the definitely unnecessary sacrifice of human life in the coal mines of the United States is due to lack of forethought in connection with many if not most of the mechanized mining and loading installations of the past decade, but more especially the last few years; in addition to lack of forethought in installation, there is far too frequently a lack of care in operating practices in mechanized mining which is little less than appalling. This condition is utterly indefensible, because while mechanized mining has its own hazards they are of a nature by no means impossible to handle; in fact, they can be overcome by methods well-known and readily applied. Moreover, mechanization has numerous advantages, notably concentration of work and workers, which give unusual opportunities for utilizing efficient supervision, with all of its educational and numerous other opportunities, far more readily and effectively than with the unorganized conditions under the older hand loading.

The 1940 accident record of United States coal mines affords very little cause for rejoicing; in fact, the situation is one that must be given very serious thought and relatively quick action if the coal-mining industry of this country is to avoid the stigma of causing not only a national but even a world-wide scandal as to callousness with which the lives of its workers are being sacrificed.

Figures 3 to 8, inclusive, are graphs of the number of fatalities in the bituminous-coal mines of the United States from 1906 - 40, inclusive, from the following causes: Fall of roof and coal, haulage, gas and coal-dust explosions, explosives, electrical contacts, and all causes. All of these graphs indicate that progress has been made, even though the favorable trend has been slow and by no means as consistent as could be desired or expected. They also indicate that especial progress has been made in reducing the number of fatalities in bituminous-coal mines in the United States since 1925 or 1926 with an all-time low in 1933 but with rather disturbing upward surges in 1937 and 1940 with respect to most of the causes of fatalities in bituminous-coal mines.

Table 10-a gives the number killed and injured in both bituminous-coal and anthracite mines from 1930 to 1940, the data for 1939 and 1940 being tentative. The Bureau of Mines did not obtain Nation-wide accident data on nonfatal injuries in coal mining until 1930.

The tabulation indicates that the rate of nonfatal to fatal injuries for the 11-year period was about 73.6 to 1 in anthracite mining and about 47.5 to 1 in bituminous-coal mining.

Generated on 2024-09-19 09:53 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:54 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

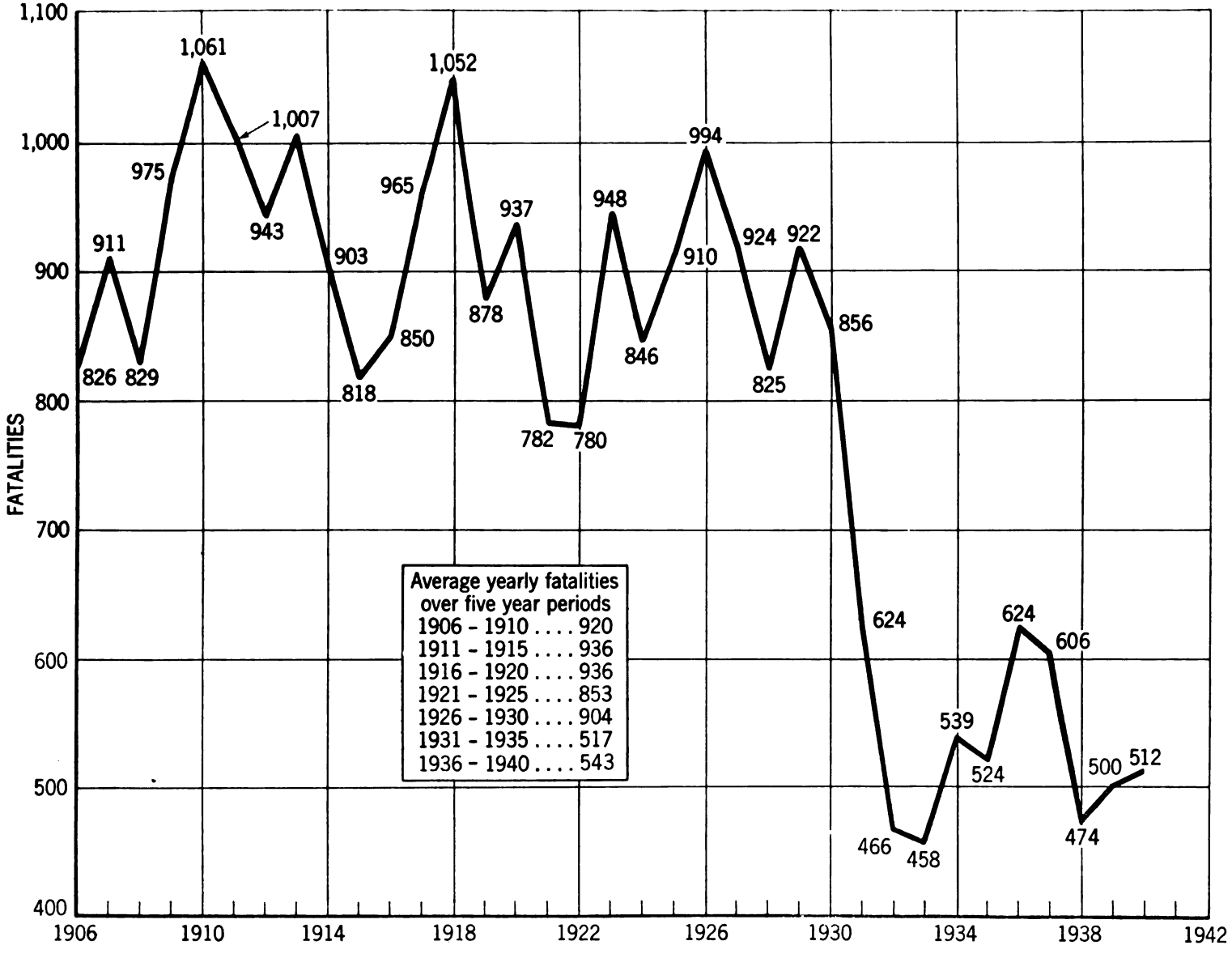

Figure 3.- Fatalities from roof and coal falls in bituminous-coal mines.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:59 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

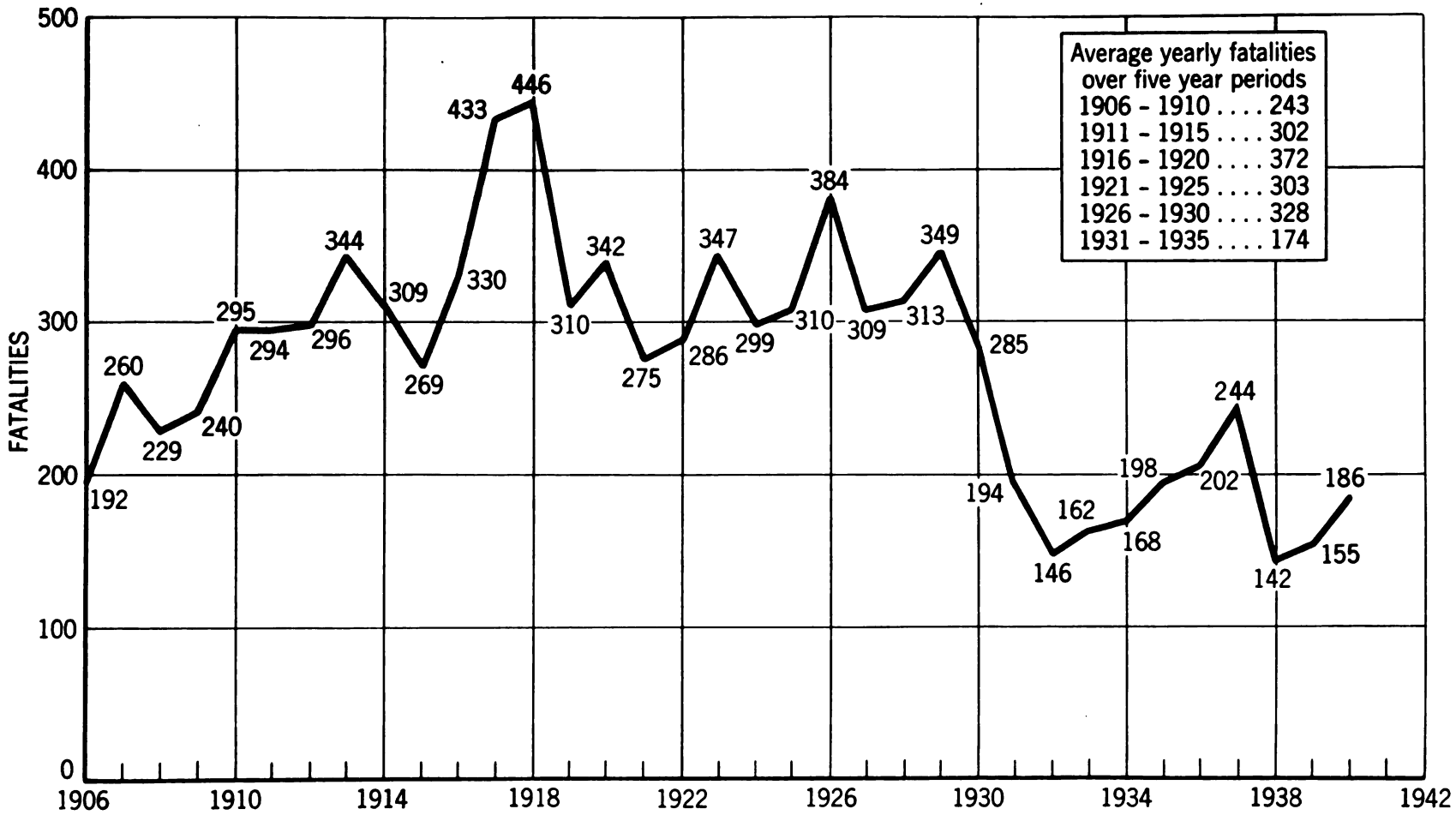

Figure 4.- Fatalities from haulage accidents in bituminous-coal mines.

Original from THE OHIO STATE UNIVERSITY

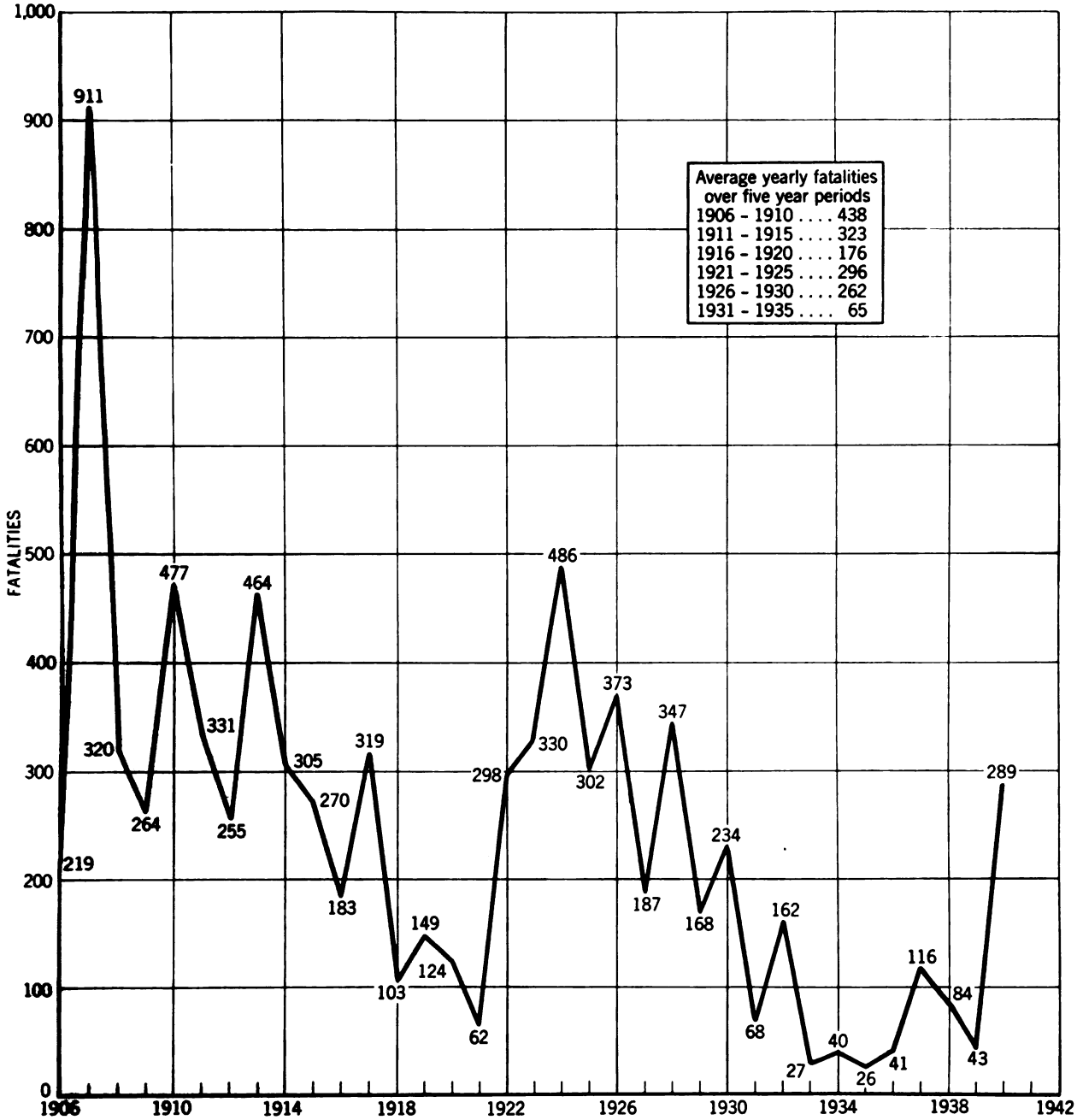

Figure 5.- Fatalities from gas and coal-dust explosions in bituminous-coal mines.

Generated on 2024-09-19 09:52 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:55 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

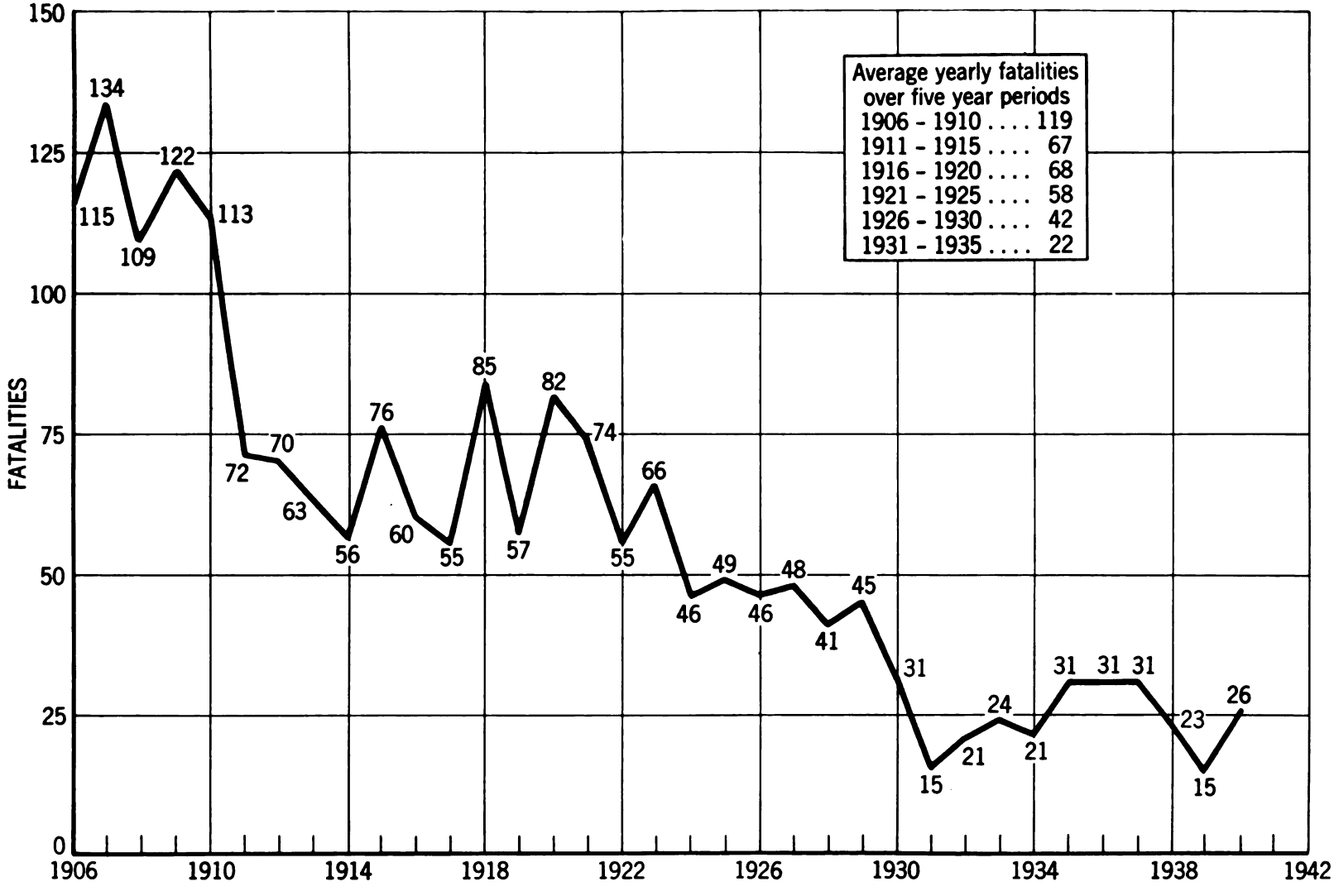

Figure 6.- Fatalities from explosives accidents in bituminous-coal mines.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:50 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

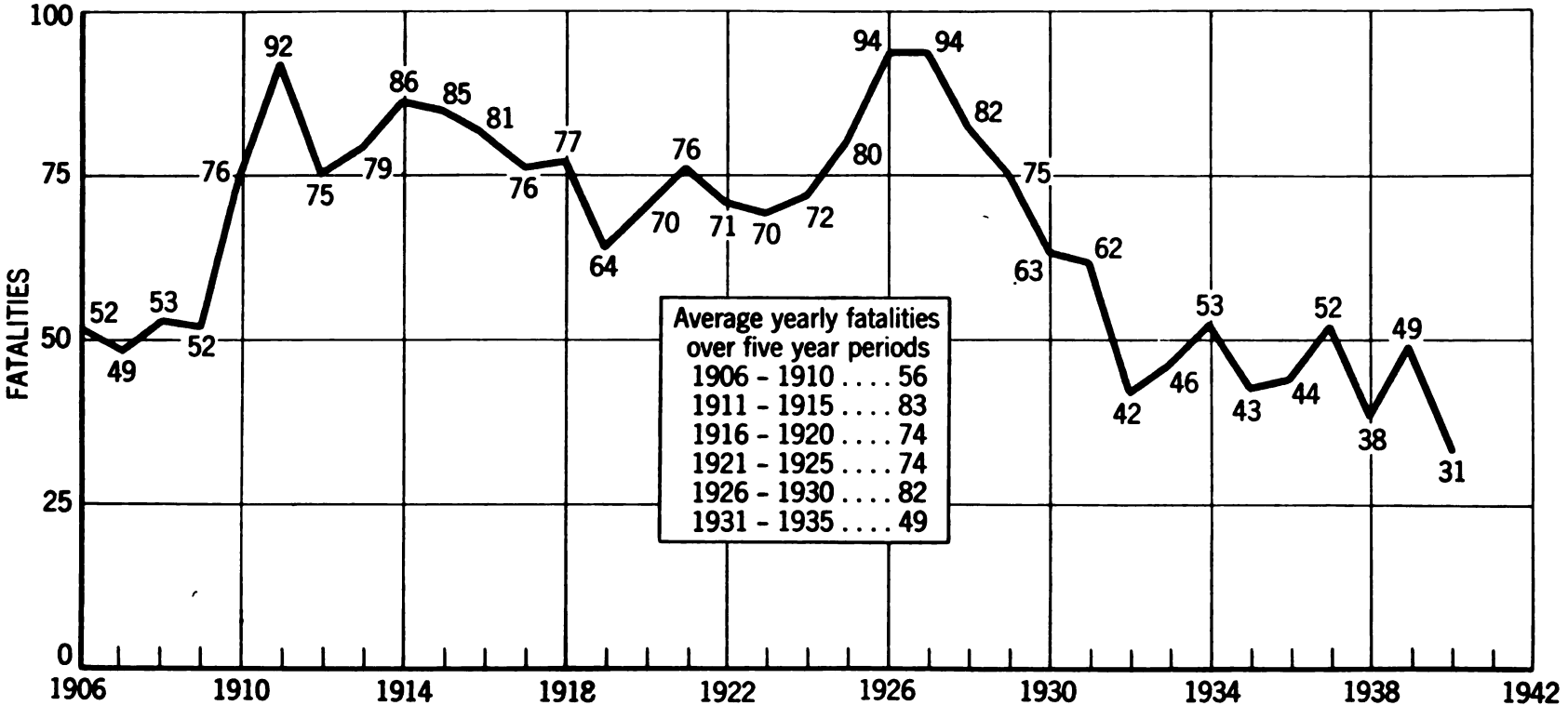

Figure 7.- Fatalities from electrical contact accidents in bituminous-coal mines.

Original from THE OHIO STATE UNIVERSITY

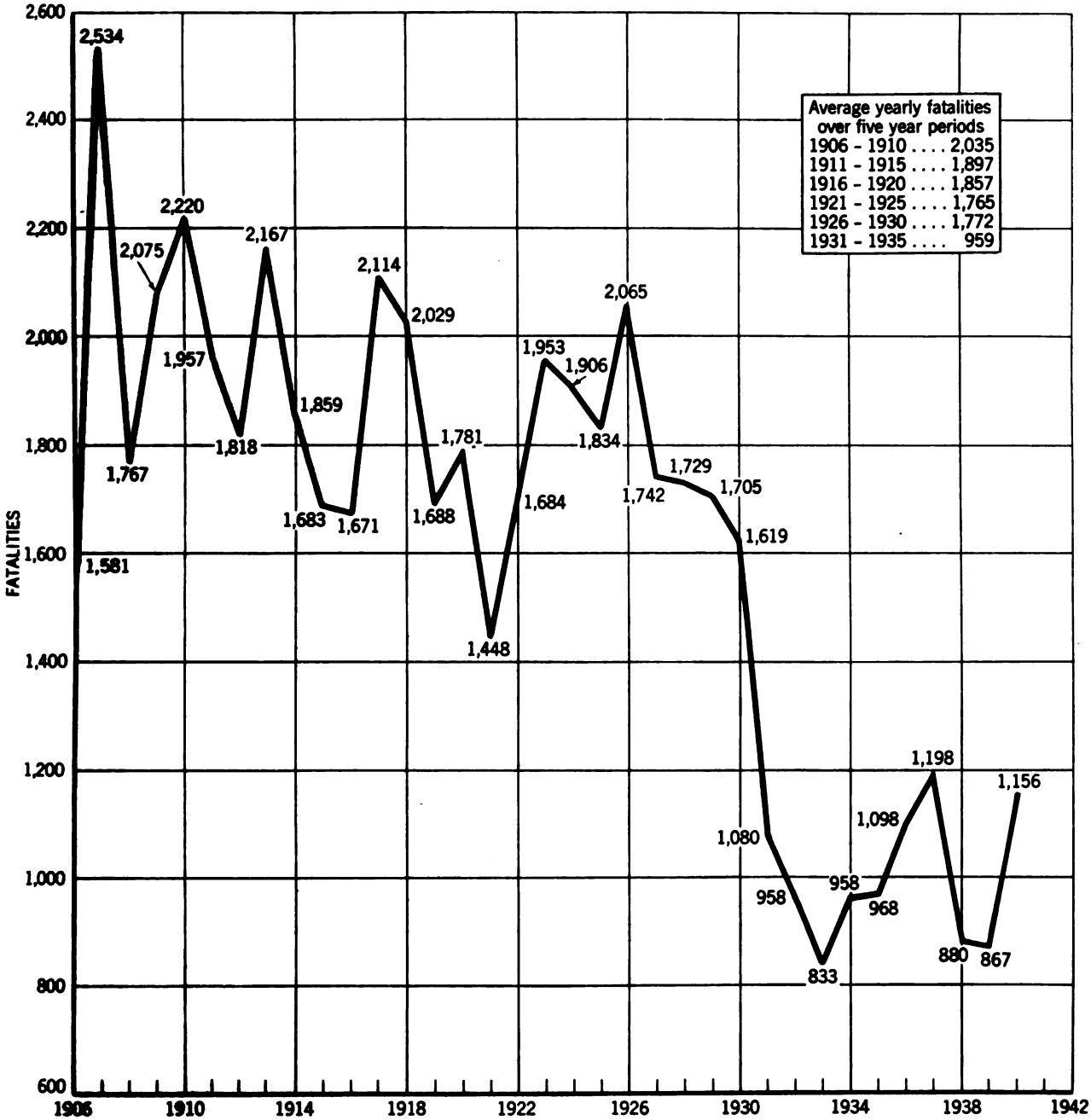

Figure 8.- Fatalities from all causes in bituminous-coal mines.

Generated on 2024-09-19 10:09 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 10-a. - Number killed and injured in coal mines of the United States, 1930 - 40

	Fatalities		Injured	
	Anthracite	Bituminous	Anthracite	Bituminous
1930	444	1,619	32,604	71,217
1931	383	1,080	26,374	53,975
1932	249	958	19,620	39,352
1933	231	833	17,367	43,946
1934	268	958	21,026	46,982
1935	274	968	18,046	47,529
1936	244	1,098	19,062	50,514
1937	215	1,198	15,430	52,847
1938	225	880	14,520	36,794
1939	211	867	1/15,471	1/38,535
1940	1/182	1/1,238		

1/ Tentative.

Table 11 shows that fatalities from explosions of gas and dust have been far less severe with respect to loss of life in anthracite mines than in bituminous mines, as may be seen by comparing the data in table 11 with information already discussed in this paper. The anthracite industry has done exceptionally well in avoiding explosion fatalities since 1930 or 1931, 1937 having a record of no fatalities from explosions. The years 1939 and 1940 were remarkably free of fatalities from explosions, there having been only three in 1939 and five in 1940. Anthracite mines escaped major disasters from June 2, 1938, to the time this paper was written (February 1, 1941), or more than 2-1/2 years, a record in which the anthracite industry may take pride.

The safety record of the bituminous-coal industry in the past year (1940) has, however, been anything but a source of pride to the industry or to the public at large, owing chiefly to the exceptionally large number of fatalities from major explosion disasters. The trend in connection with major disasters in bituminous-caol mining has been anything but favorable since the fall of 1937, even though there was only one major explosion disaster in 1939, with its resultant 28 fatalities.

The causes of the increase in severity of coal-mine disasters in the relatively recent past after they apparently had been almost eliminated in 1933, 1934, 1935, and 1936, are not definitely known, although the increase may be due to some extent to increased activity in the coal-mining industry together with some changes in mining practices that have resulted in a relaxation of safety precautionsor in failure to take additional precautions to ward off new hazards because of the newer practices or conditions.

Since 1932 coal mines in the United States have shown a reasonable tendency to reduce the number of accidents, but much of the progress made has been in curbing fatalities from mine disasters. In this period mechanized-loading bituminous-coal mines have been the scene of mine disasters aggregating more than 300 fatalities, whereas disaster fatalities in non-mechanized-loading bituminous-coal mines have aggregated slightly more than 100. In other words, highly mechanized bituminous-coal mines, which produced not more than one-third of the country's bituminous coal, had at least three-fourths of the fatalities resulting from major disasters.

Generated on 2024-09-19 09:54 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 11. - Number killed in anthracite mines by gas and dust explosions - 1911-40

Year	Killed, gas and dust explosions
1911.....	34
1912.....	35
1913.....	50
1914.....	44
1915.....	34
1916.....	43
1917.....	41
1918.....	26
1919.....	42
1920.....	36
1921.....	64
1922.....	13
1923.....	42
1924.....	50
1925.....	43
1926.....	49
1927.....	60
1928.....	29
1929.....	27
1930.....	30
1931.....	20
1932.....	7
1933.....	13
1934.....	12
1935.....	23
1936.....	17
1937.....	-
1938.....	20
1939.....	3
1940.....	5

The mechanization of coal mines unquestionably introduces additional explosion and other hazards, although it affords numerous opportunities to decrease many types of hazards that accompany more primitive mining practices and methods. In addition to the mechanical hazards involved in mechanized mines, there is almost invariably a considerable concentration of workers readily susceptible to injury from any untoward occurrence; moreover, the more rapid extraction of coal as a result of mechanical loading liberates greater quantities of gas and dust in a given period than does hand loading, and the gas is liberated in the presence of an increased number of sources of ignition, chiefly in connection with electrically operated equipment. Consequently, better ventilation must be provided and greater vigilance maintained in the detection of gas and elimination or neutralization of dust. Many explosions result directly or indirectly from carelessness or infraction of rules by employees and many from unsafe methods, installations, or practic

Generated on 2024-09-19 09:52 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

(or all three) for which the management is responsible; therefore, the prevention of explosions is the responsibility not only of the management but also of the workers. Irrespective of responsibility, there is no question as to the seriousness of the situation brought about by the very bad coal-mine disasters of the past 3-1/2 years (including the Mulga disaster of October 1937); and all persons engaged in coal mining, especially those trying to reduce accident occurrence in the coal mines of the United States, are now confronted with the difficult problem of trying to equal the exceptionally good record of the fiscal year 1939, when no major explosions occurred.

During the winter the cold air entering mines absorbs moisture and dries the coal dust, making it more capable of being raised into the air, more readily ignited, and more violently explosive upon ignition; and during these months particular precautions should be taken to prevent accumulations of explosive gas or dust and the initiation of an explosion. This applies even more emphatically to our modern mechanized mines than to those still using the most primitive hand-loading methods.

Pulverized rock dust, such as that from limestone, should be applied in bituminous and lignitic coal mines to walls, roof, and floor of mine passages to prevent propagation or extension of an explosion. When an ignition of gas or of pure coal dust or a combination of both occurs, this pulverized rock dust and the coal dust present on adjacent surfaces (floor, roof, and walls) are raised into the air. The rock dust prevents the coal dust from igniting, which localizes the flame and prevents the explosion from spreading, or "propagating" as it is termed. Experiments and experience have shown that an explosion will not propagate or extend any considerable distance from its origin in a mine that has been well-rock-dusted. Unfortunately, most mine operators have not seen fit to rock-dust their mines, others have done so only partly, whereas many an efficiently rock-dusted mine of today has become inefficient in a few days through failure to continue the dusting, although the cost of keeping a mine effectively rock-dusted is trivial (about 1 or 2 cents, and almost invariably less than 3 cents, per ton of coal produced). The partial rock-dusting of mines gives little or no real protection; in fact, it fosters a false sense of security, and in many instances the result is even worse than if no rock-dusting were done. To provide adequate assurance against widespread explosion disasters in coal mines all accessible open areas should be thoroughly rock-dusted, including haulage entries, aircourses, rooms, crosscuts, short or long faces, and pillar regions; and the rock-dusting should be repeated from time to time so as to hold the incombustible content of the rib, roof, and floor dusts at all times to over 65 percent. It is a certainty that fewer than 5 percent (probably not more than 1 percent) of the coal mines of the United States are adequately or efficiently rock-dusted.

The marked increase in explosion fatalities during the past year spoils an excellent record that had been maintained during the previous 7 to 9 years; and there is reason to believe that unless our coal-mining people awaken to the fact that coal-mine disasters are likely to occur unless constant care is exercised with ventilation, lighting, use of electricity, explosives, haulage

Generated on 2024-09-19 10:00 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

equipment, and other factors entering into the initiation of explosions, we shall again have the reprehensible disaster records of 10, 20, or more years ago, when coal-mine catastrophes normally took 300 to 500 lives annually.

On the other hand, if the readily available precautionary measures for the prevention of widespread explosion disasters are adopted and kept in effect, and heavy fatal-accident occurrences from explosions are avoided, the record for the past several years (including 1940, if major disaster fatalities are excluded) shows very clearly that accident occurrences from other causes in the coal mines of the United States are being reduced steadily, even if somewhat slowly, and there is good reason to believe that at last the far too high accident rate of the coal mines of the United States will be lowered so as to be comparable with those of other major industries having more or less similar difficulties to overcome.

Metal and NonMetallic Mineral Mines (Non-Coal-Producing Mines)

Not even tentative figures are available as to accident occurrence in the noncoal mines of the United States for 1940, though the year was free of major disasters in these mines. That the metal and nonmetallic mineral or noncoal mines of the United States have been doing a good job in the reduction of accidents is shown conclusively in figure 9, though much of this has been due to decreased employment in recent years. There has also been an unmistakably upward trend from the all-time low record for fatal accidents of 1933, though again this has been due chiefly to the rise in production since 1933.

Table 12 shows a gradual but very definite decline in the number of men employed and in the number of shifts worked in the metal and nonmetallic mineral mines of the United States beginning with the 5 years 1912-16 and including 1932-36 (when a definite "low" was reached) as well as a fairly definite trend upward in both number employed and shifts worked in 1937, 1938, and 1939. The table shows that the fatal-accident rate has declined slowly but consistently and steadily from the average of 3.84 persons killed per thousand 300-day workers in the period 1912 to 1916 to the average of 2.46 for the period 1932 to 1936 and to 2.20 in 1937 and 1.99 in 1938 and 1939.

Figure 10 shows the erratic nature of accident occurrence in the various kinds of metal mines as well as nonmetallic mineral mines of the United States from 1911 to 1939. Some of the high points on the curves are due to the occurrence of disasters, chiefly fires: The high peak in copper mining in 1917 is due to the mine-fire disaster at the North Butte mine in 1917, when 163 lives were lost, and the high peak in the curve for gold and silver mining in 1922 was caused by 47 fatalities from the Argonaut mine fire in California.

Generated on 2024-09-19 09:56 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:53 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

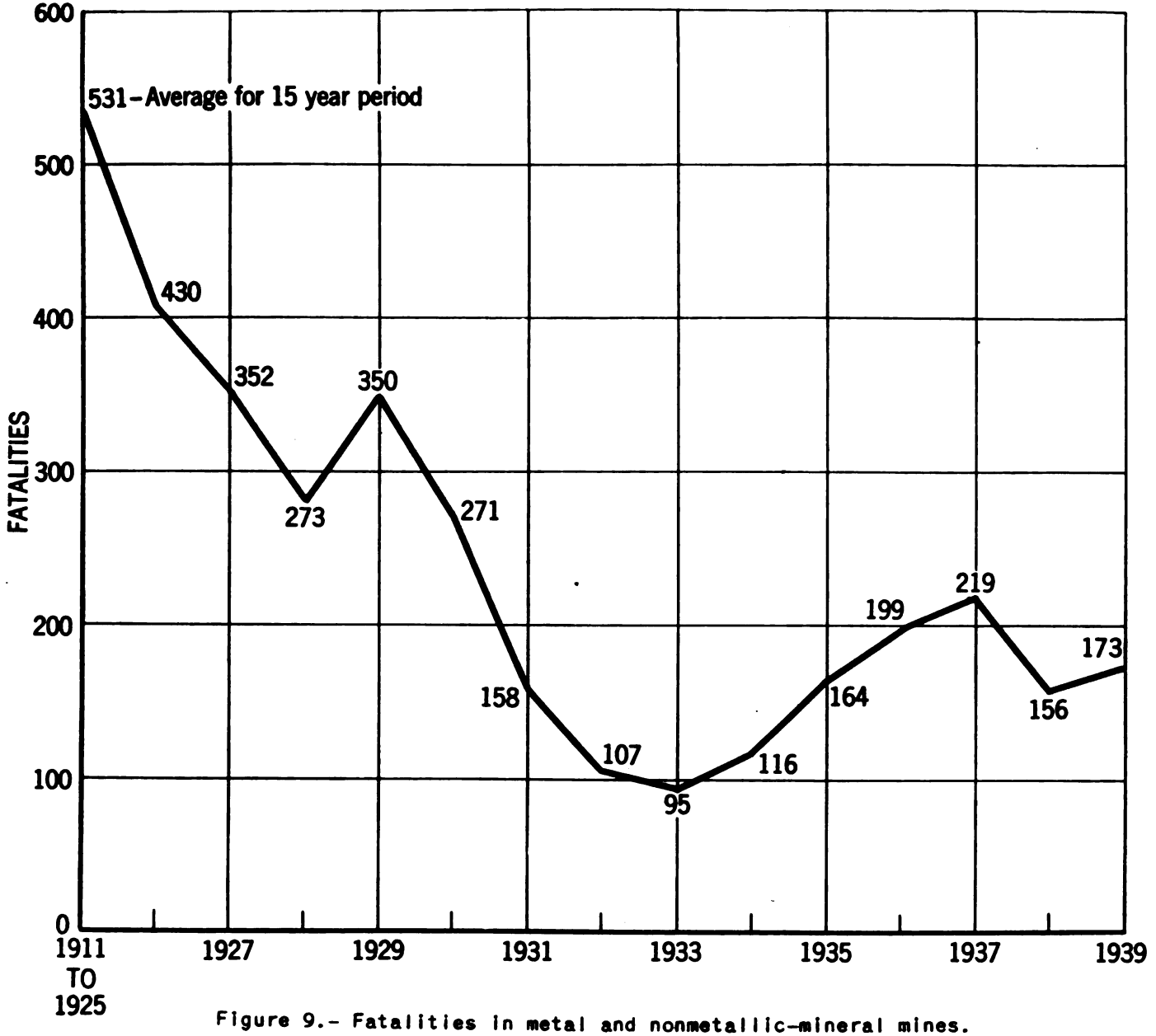

Figure 9.- Fatalities in metal and nonmetallic-mineral mines.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:59 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

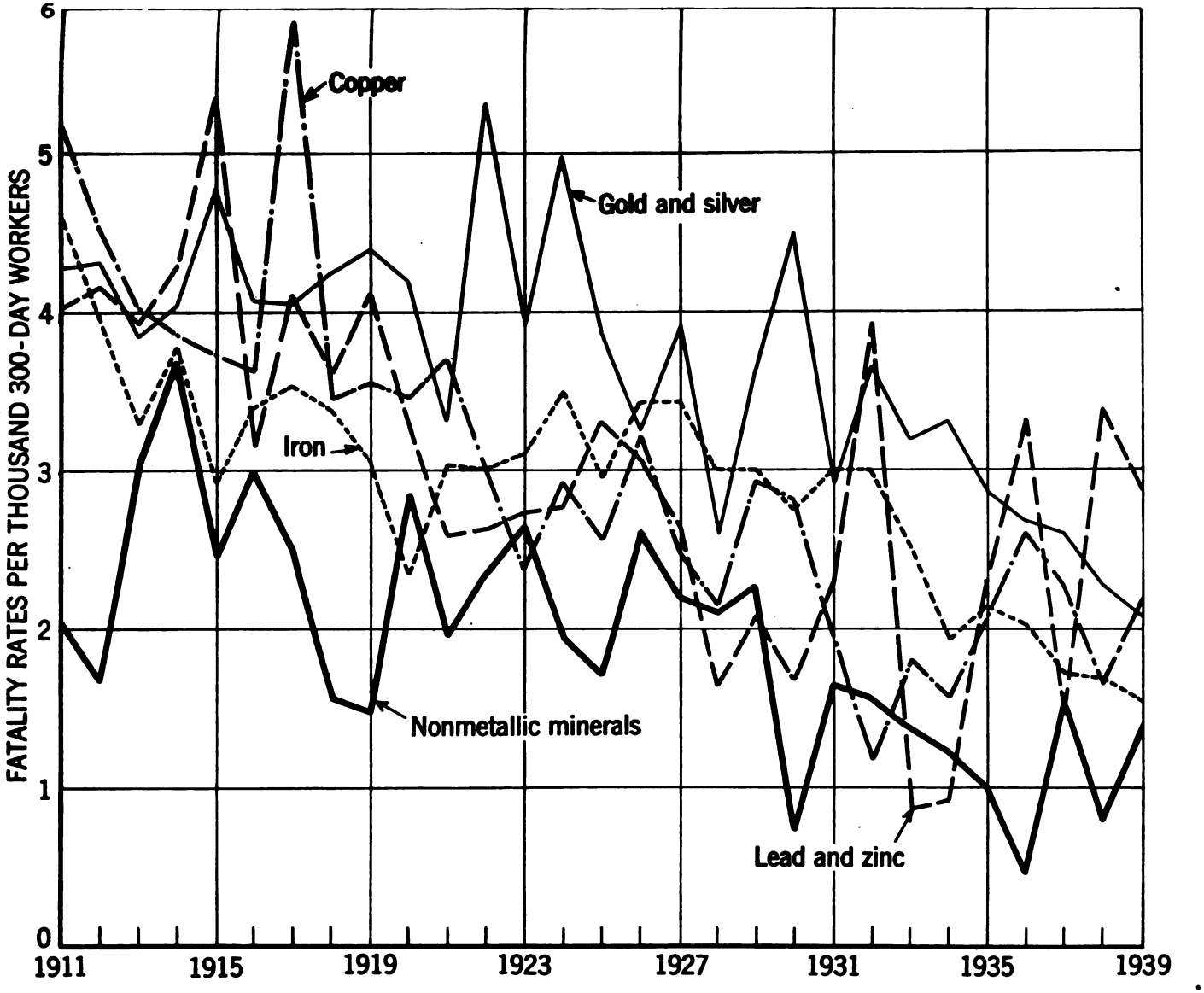

Figure 10.- United States metal and nonmetallic-mineral mines: Fatality rates per thousand 300-day workers, 1911-39.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 12. Data on fatal and nonfatal injuries in metal and nonmetallic mineral mines, 1912 - 39

Years	Average number employed	Average shifts worked	Average number killed	Average number injured	Average number killed and injured per thousand 300 day workers		
					Killed	Injured	Killed and injured
) years - 1912-16, incl.	174,949	49,303,387	631	35,491	3.84	215.95	219.79
) years - 1917-21, incl.	151,792	43,020,701	524	34,375	3.65	239.71	243.36
) years - 1922-26, incl.	121,328	35,153,689	386	31,649	3.29	270.09	273.38
) years - 1927-31, incl.	107,295	29,609,432	281	19,002	2.85	192.53	195.38
) years - 1932-36, incl.	74,039	16,604,554	136	8,737	2.46	157.85	160.31
937.....	118,429	29,856,610	219	18,055	2.20	181.42	183.62
938.....	103,027	23,505,364	156	12,722	1.99	162.37	164.36
939.....	111,909	26,032,368	173	13,710	1.99	157.99	159.98

Table 13 gives accident data for metal and nonmetallic mineral mines for 1926 o 1939, inclusive, and inspection of the table reveals that all of the subdivisions f the metal-mining industry as well as nonmetallic mineral mining have made progress n reducing both the fatal and the nonfatal accident rates since 1926, even though hat progress has been slow and not very great.

TABLE 13. - United States metal and nonmetallic mineral mines: Accident rates per thousand 300-day workers, 1926-39

ear	Copper		Gold, silver, miscellaneous		Iron		Lead and zinc (Mississippi Valley)		Nonmetallic mineral		Total	
	Killed	In-jured	Killed	In-jured	Killed	In-jured	Killed	In-jured	Killed	In-jured	Killed	In-jured
926	3.45	288.3	3.27	299.5	4.23	133.9	3.05	304.2	2.62	190.7	3.47	245.0
927	3.46	261.2	3.91	279.8	2.45	114.6	2.64	297.7	2.19	171.2	3.10	221.5
928	3.03	221.0	2.60	268.7	2.16	98.1	1.02	295.7	2.13	168.6	2.50	205.6
929	3.03	223.8	3.66	269.4	2.08	89.6	2.08	238.3	2.29	168.1	3.03	200.1
930	2.76	193.5	4.49	239.7	2.68	81.4	1.63	176.6	.75	138.3	2.92	167.9
931	3.01	152.5	2.88	190.0	1.91	52.7	2.56	176.6	1.63	124.3	2.53	139.6
932	3.01	112.5	3.66	179.3	1.68	44.6	3.95	164.8	1.56	117.6	2.89	135.6
933	2.49	130.3	3.20	204.0	1.42	50.6	.85	147.6	1.39	129.3	2.45	152.7
934	1.96	109.0	3.33	227.5	1.79	48.3	.91	196.1	1.23	121.3	2.36	160.8
935	2.05	157.8	2.86	182.7	2.15	42.9	2.26	166.0	1.01	116.9	2.42	150.4
936	2.62	194.2	2.70	224.8	2.01	60.3	3.33	135.5	.45	116.5	2.37	174.3
937	2.26	228.0	2.60	226.2	1.73	72.6	1.47	123.8	1.52	115.6	2.20	181.4
938												
939												

336

Generated on 2024-09-19 09:51 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 14. - Relative standing of States having 1,000 or more men employed at metal and nonmetallic mineral mines in 1937, classified according to number of men employed and fatality and injury rates per million man-hours of labor performed

Relative standing	State	Men employed	Relative standing	State	Fatality rate 1/	Relative standing	State	Injury rate 1/
1	California 2/	14,131	1	Florida	0.00	1	Minnesota	14.07
2	Montana	11,407	2	Oregon	.00	2	Michigan	23.88
3	Arizona	11,160	3	Oklahoma	.37	3	Alabama	24.20
4	Minnesota	9,484	4	Utah	.41	4	Missouri	33.48
5	Michigan	8,537	5	Tennessee	.45	5	Florida	36.36
6	Colorado	6,947	6	Alaska	.49	6	Tennessee	39.25
7	Utah	6,350	7	Michigan	.55	7	South Dakota	41.91
8	Idaho	5,998	8	Minnesota	.55	8	Texas	43.12
9	Nevada	5,176	9	Washington	.64	9	Virginia	46.56
10	Alaska	4,612	10	Missouri	.66	10	Alaska	46.94
11	Alabama	4,555	11	Nevada	.66	11	New Jersey	55.42
12	Oklahoma	3,410	12	Texas	.67	12	Kansas	58.47
13	New Mexico	3,332	13	Alabama	.76	13	Oklahoma	66.17
14	Missouri	2,368	14	Arizona	.77	14	Utah	80.13
15	Tennessee	2,094	15	South Dakota	.82	15	Nevada	86.74
16	South Dakota	2,005	16	Virginia	.94	16	California	89.48
17	New York	1,978	17	Montana	1.00	17	Colorado	102.19
18	Texas	1,928	18	California 2/	1.04	18	New Mexico	109.95
19	Kansas	1,777	19	New York	1.13	19	Oregon	111.55
20	New Jersey	1,156	20	Kansas	1.24	20	Montana	112.01
21	Oregon	1,119	21	New Jersey	1.25	21	Arizona	115.50
22	Virginia	1,060	22	Idaho	1.48	22	Washington	123.26
23	Washington	1,056	23	New Mexico	1.53	23	Idaho	123.93
24	Florida	1,001	24	Colorado	2.62	24	New York	136.71
	United States Total....	118,429		United States Average....	0.91		United States Average..	75.37

1/ Number of deaths or injuries per million man-hours of exposure.
2/ Major disaster.

This table gives the latest available statistics on several phases of accident occurrences in the various States of the Union where metals or nonmetallic minerals are mined, including number of men employed as well as relative standing in respect to fatal- and nonfatal-injury rates. It is noted that California employed the largest number of noncoal miners in 1937, with Montana and Arizona not far behind; also, that of the States employing 5,000 or more noncoal miners Michigan had the best fatal-accident rate and Minnesota the best nonfatal-accident rate, with Minnesota second to Michigan as to fatal-injury rate and Michigan second to Minnes as to nonfatal-injury rate.

Generated on 2024-09-19 09:59 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Table 15 contains some informative data on the relative freedom of the metal and nonmetallic-mineral mines of the United States from mine-fire disasters in the past 15 years. Metal mine fires with heavy loss of life are now a rarity; fire disasters in noncoal mines, such as those at the Pennsylvania mine in Butte, Mont., in 1915 with 21 deaths; the North Butte mine, also at Butte, Mont., in 1917, with 163 fatalities; and the Argonaut (Calif.) mine fire in 1922, with 47 deaths, have not occurred during the past decade and a half; and it is believed that much of this relative immunity from heavy loss of life in metal-mine fires is due to the fact that the fires above-mentioned, with others that occurred 15 to 25 years ago, afforded the metal-mining people an object lesson, which they took to heart and haven't forgotten. Certainly, one of the reasons for the less frequent occurrence of fire disasters in metal mines is the acknowledgment of those who operate metal mines that virtually all mines have fire hazards, even if the mines are damp to wet and even though the product of metal mines usually will not burn. This, with the rather general adoption of fairly effective ventilating systems and the fairly widespread adoption of electric cap lamps by metal miners have aided much in preventing metal-mine fire disasters in the past 15 years.

TABLE 15. - Number killed in mine fires in the metal and nonmetallic mineral mines of the United States, 1925-39

Year	Killed			Injured		
	Metal	Nonmetal	Total	Metal	Nonmetal	Total
1925	1	-	1	18	-	18
1926	3	-	3	9	-	9
1927	7	-	7	1	-	1
1928	1	-	1	10	-	10
1929	3	-	3	4	-	4
1930	6	-	6	5	-	5
1931	-	-	-	-	-	-
1932	-	-	-	1	-	1
1933	-	-	-	-	-	-
1934	-	-	-	-	-	-
1935	-	-	-	12	-	12
1936	-	-	-	6	2	8
1937	-	-	-	1	-	1
1938	2	-	2	9	-	9
1939	-	-	-	-	-	-

The national-defense program caused a heavy increase in mining activity respecting nearly all types of metal and nonmetallic minerals, and this is expected to materially increase both the extent of accident occurrence, including fatalities, and also accident rates. Much of this increase will be due to the increase in untrained and unskilled personnel and to the greatly augmented interest in development of small mines, both new and old, because, particularly at the beginning of operations, small mines are not likely to be safety conscious.

8336

Generated on 2024-09-19 09:52 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

With the greater demand for certain strategic minerals or metals, such as mercury, manganese, and chromium, there have arisen some definite problems both as to health and safety, including mercury, manganese, or chrome poisoning; and in these new or recently reopened properties the tendency is to drill dry with little or no ventilation, which increases the silicosis hazard and hence increases the possibility of asphyxiation from fumes from explosives or the by no means remote probability of ignitions of explosive gas (methane), which is found frequently in properties in some of our Western States where ores of mercury as well as some other minerals are mined.

With the increase in metal mining in recent years and the accompanying tendency to reopen old mines or abandoned parts of operating mines, the problem of men entering long-unventilated workings while wearing electric cap lamps has been forced to attention in some regions where ventilation has not been provided for or where oxygen and methods or equipment to detect deleterious atmospheres (chiefly those containing a high percentage of carbon dioxide or nitrogen, and sometimes methane) are lacking. Unquestionably the electric cap lamp is the most efficient as well as the safest type of miner's lamp yet devised, but it has the weakness of giving no warning whatsoever as to the nature of the atmosphere in which it is used. This problem must be solved before the electric cap lamp can be considered absolutely safe for underground use. Meanwhile, until an adequate solution of the problem has been reached it is very essential that wearers of electric cap lamps have with them some device, such as a lighted candle (or a lighted flame safety lamp, if explosive gas is suspected) when entering long-abandoned, unventilated, underground workings. Moreover, abandoned, unventilated regions in metal mines where electric cap lamps are used should be sealed off, or at least "dangered off", to prevent men wearing electric cap lamps from entering them, and the metal-mining company that neglects ventilation yet uses electric cap lamps as the light for its workings runs the risk that men will be asphyxiated.

Although no major disasters (those in which five or more persons have been killed at one time) have been reported in metallic and nonmetallic mineral mines during the past year, several accidents have occurred in which more than one person was killed or injured, chiefly due to blasting or blasting fumes. Blasting accidents in metal mines have been due to a variety of causes: Short fusing or remaining too long to light fuses; ramming explosives with a metal bar and causing premature blasts, or in some instances hitting detonators or primers in a partly misfired hole intersecting at an angle the one on which work was being done; coming back too soon and being killed by a so-called dela shot, or being asphyxiated by carbon monoxide or other gases from the detonate explosive, or from H_2S or gas released from the surrounding material which was blasted; as well as numerous other causes.

During the year there were some accidents from double-primed shots, and this precipitated a discussion as to the advisability of double priming. At a meeting of metal-mining men in the West a brisk discussion arose as to the correct place of the priming stick in the hole; not only metal-mining men of years of experience but also explosives manufacturers' representatives entered actively into the discussion, but there was anything but unanimity of opinion, and the discussion failed utterly to solve the problem. In this same discussi

Generated on 2024-09-19 09:50 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

much was said, pro and con, as to the advisability of having at least one stick of explosive in the drill hole preceding the priming stick; as to this, too, there was anything but agreement. The meeting also discussed accidents from racing fuse, but the representatives of the explosives manufacturers were very positive that racing-fuse accidents are almost invariably due to short fusing or remaining too long to light fuses.

The extension of the use of electric blasting in metal and nonmetallic-mineral mines, both surface and underground, has brought out the fact that electric blasting has its own hazards and that one of them, stray currents, must be given very careful consideration; there, again, the problem has not been solved. The possibility of premature firing of shots prepared for electric blasting by lightning has come to the front, and the hazard is recognized as serious, not only for surface workings but also for underground properties. Stray currents are found relatively easily between metallic circuits, such as rails and pipe, and each other between rails or pipe and the more or less adjacent rock or other strata. However, some mining people suspect the existence of stray currents between different kinds of rock or ore strata, though there are few or no definite data to substantiate this belief.

During 1940, the State of New York adopted some drastic rules in connection with the handling of blasting fumes, embodied in Industrial Code Rule No. 25 (effective March 1, 1940) entitled "Toxic Gases In Mines, Tunnels, and Shafts." These rules are somewhat similar to regulations issued in California a few years ago. Somewhat similar rules are under consideration for the metal mines and quarries of Alabama. Previously New York State adopted some stringent rules on the Control of Silica Dust in Rock Drilling (Bull. 33).

Although 1940 was free of very bad accidents or other losses due to mine fires, numerous metal-mine fires did occur; in some of these the existence or nonexistence of well-controlled ventilation had a vital effect. The ability to control direction of airflow by using doors or by reversing direction of airflow at the main fan helped materially to control some mine fires; on the other hand, in at least one mine fire where there was essentially no control of direction or amount of air flow, the fire quickly got out of control. One very serious fire occurred in the surface head frame of a noncoal mine that had only one opening - a shaft - but fortunately the 100 or more employees ordinarily employed in the mine were not underground at the time. This episode, however, calls attention to the very grave hazard of fire (surface or underground) at mines with but one opening.

Numerous fires have been caused in and around both coal and metal mines in recent years by carelessness in the use of such devices as oxy-acetylene welding and cutting equipment; in particular, several fires have been caused in surface tipples and head frames and in timbered shafts from highly-heated particles coming in contact with timber. Utmost precautions should be taken in using these very efficient devices and equipment, and in this connection it might be well to become familiar with the information contained in an excellent pamphlet entitled "Precautions and Safe Practice in Welding and Cutting with Oxy-acetylene Equipment," issued in 1939 by The Linde Air Products Co., New York.

Generated on 2024-09-19 09:52 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The high cost of accidents is emphasized by the exceptional case of Jack Schaub, as given in the Report of the Department of Industrial Relations of California to the Governor of California in February 1940, as follows:

> Jack Schaub was injured on December 13, 1917, while employed by The Lloyd Co. of Petaluma. It was not then expected that Mr. Schaub could live 6 months. A fighting heart and a determined will kept him alive almost 15 years, much to the amazement of the doctors who have cared for him. Paralyzed from the waist down, he was practically bedridden since his injury, and always confined in the hospital, up to the date of his death, August 17, 1932. The total cost of the case, including medical expense and disability indemnity, over a period of approximately 15 years, was $45,570.67.

During 1940 two progress reports3/ on stemming in metal mines, which contain information gained from experiments conducted by the Bureau of Mines at its rock tunnel at Mount Weather, Va., were issued. The first contained data chiefly as to the effect of stemming or nonstemming of blasting holes in rock on the occurrences of dust. The second contained similar data on the occurrence of poisonous or asphyxiating gases in blasting rock with no stemming and with both noncombustible and combustible stemming.

Much progress has been made in driving the longest tunnel in the history of the world, namely, the 85-mile Delaware aqueduct bore to convey water from upper New York State to New York City, the total estimated cost of the project being $236,000,000. It was announced that the expectancy of fatalities in this tunnel construction was one per $1,000,000 of contract price, but as a result of numerous precautionary safety measures adapted and enforced the actual driving has been done at a rate of 1 fatality for every $1,250,000 of contract price a nice saving of both lives and money. As of December 1, 1940, this project was approximately 59 percent completed. On November 25, 1940, it was announced that the 42d tunnel on the Colorado River aqueduct project in Southern California had been holed through. This Southern California aqueduct project, in which more than 100 miles of tunnel were driven with a high degree of safety, is now nearing completion.

In one of the western metal-mining States with a large number of small operations, many of them engaged in mining or prospecting for strategic mineral compensation-insurance rates were high; but even so the insurance companies lost money, because accident occurrences were heavy and serious accidents were frequent. A safety campaign was instituted in the spring of 1940, and after 6 months it was found that instead of paying out 105 percent of premiums paid in, as had been the case for the year before the safety program was adopted, the rate was but 41.1 percent for the 6 months in which the safety program was in effect, and it seemed probable that it would decline still farther during the next 6 months. Evidently safety work pays well for small as well as large mines, and the benefits go to both employer and employee.

3/ Johnson, John A., Agnew, Wing G., and Mosier, McHenry, stemming in metal mines: Progress Rept 1: Bureau of Mines Rept. of Investigations 3509, 1940, 27 pp.
Johnson, John A., Agnew, Wing G., and Mosier, McHenry, stemming in metal mines: Bureau of Mines Rept. of Investigations 3528, 1940, 39 pp.

Generated on 2024-09-19 10:00 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

In an effort to provide a suitable (safe as well as efficient) substitute for the trolley-locomotive haulage system in underground workings some extensive experiments have been conducted with specially constructed Diesel mine-haulage locomotives in some of the tunnels on the Delaware aqueduct tunneling project in New York. To date the experiments have shown that possibly with some additional modifications in design and construction of these locomotives and with suitable provision for ventilating the workings in which the locomotives are used a Diesel locomotive of suitable construction will be available, which can be utilized far more efficiently and safely than the trolley locomotive with its numerous draw-backs from a safety viewpoint.

Accident statistics for the quarrying industry are not available for 1940 at this time, but table 16, which was taken from a Bureau of Mines statistical release, gives some interesting information as to what happened in accident occurrence in and around the quarries of the United States in 1939. The table shows that Pennsylvania was by far the largest employer in quarrying, with 13,044 engaged in the industry in that State in 1939; Ohio was second with 5,510, and Indiana was third with 4,235. The 1939 quarry-fatality rate of 0.33 killed per million man-hours was much lower than the 0.61 rate of 1938, and the nonfatal-injury rate of 36.18 persons injured per million man-hours was somewhat lower than the 37.58 rate in 1938. Of the larger quarry employing States, Pennsylvania did the best job in the avoidance of fatalities with a rate of 0.12 fatalities per million man-hours of exposure, while Ohio topped the larger employing States in the avoidance of nonfatal injuries with a rate of 21.06 nonfatal injuries per million man-hours.

Table 17 summarizes accident occurrences in the quarries of the United States from 1926 - 39, inclusive (figures taken from Bureau of Mines statistical publications). The table indicates that the fatal-accident rate in quarries, 0.33 fatality per million man-hours of exposure, is the lowest since 1926 (in fact, it is the lowest since at least 1911); the nonfatal rate of 36.18 nonfatal injuries per million man-hours of exposure is also the lowest since 1926 (but not as low as the recorded rates for 1911, 1912, and 1913, when, however, reporting on nonfatal accidents was anything but precise). Very evidently the extensive safety work being done in quarries is getting good results.

Generated on 2024-09-19 10:00 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:55 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 16. - Employment and accidents at quarries and related plants, by States, during 1939

State	Men employed - At quarry	Men employed - At outside works	Men employed - Total	Killed	Nonfatal injuries: Permanent total disability 1/	Nonfatal injuries: Permanent partial disability 2/	Nonfatal injuries: Temporary 3/	Nonfatal injuries: Total nonfatal	Rate per million man-hours: Killed	Rate per million man-hours: Injured
Alabama.....	944	1,444	2,388	1	-	5	132	137	0.23	30.97
Arizona.....	151	91	242	-	-	-	7	7	-	13.13
Arkansas.....	104	139	243	-	-	-	33	33	-	73.43
Califronia....	1,329	2,188	3,517	4	-	6	262	268	.61	40.61
Colorado.....	266	270	536	2	-	3	50	53	2.20	58.30
Connecticut...	298	188	486	1	-	3	44	47	1.04	49.02
Florida.....	332	444	776	1	1	-	99	100	.70	70.21
Georgia.....	764	1,105	1,869	3	-	2	90	92	.90	27.65
Idaho.....	72	75	147	-	-	2	5	7	-	47.48
Illinois.....	1,909	1,797	3,706	2	-	3	151	154	.35	27.21
Indiana.....	1,457	2,778	4,235	4	-	5	250	255	.54	34.21
Iowa.....	499	1,167	1,666	-	-	3	36	39	-	13.04
Kansas.....	683	874	1,557	-	-	1	39	40	-	15.99
Kentucky.....	912	506	1,418	1	2	1	132	135	.43	57.42
Maine.....	541	545	1,086	-	-	-	54	54	-	42.74
Maryland.....	483	523	1,006	3	-	-	81	81	1.71	46.27
Massachusetts.	622	688	1,310	1	-	1	104	105	.42	43.61
Michigan.....	1,015	2,427	3,442	-	-	5	62	67	-	9.62
Minnesota.....	627	954	1,581	1	-	3	106	109	.38	41.67
Missouri.....	2,048	1,833	3,881	3	-	8	311	319	.48	50.97
Montana.....	488	91	579	-	-	2	43	45	-	54.17
Nebraska.....	79	240	319	-	-	-	5	5	-	8.06
New Hampshire.	117	144	261	-	-	-	12	12	-	31.09
New Jersey....	485	607	1,092	-	-	-	77	77	-	38.85
New York.....	1,653	2,330	3,983	2	-	20	134	154	.29	22.17
North Carolina	531	489	1,020	-	-	4	63	67	-	34.89
Ohio.....	2,220	3,290	5,510	3	-	5	219	224	.28	21.06

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:52 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 16. - Employment and accidents at quarries and related plants, by States, during 1939 (continued)

State	Men employed - At quarry	Men employed - At outside works	Men employed - Total	Killed	Nonfatal injuries: Permanent total disability 1/	Nonfatal injuries: Permanent partial disability 2/	Nonfatal injuries: Temporary 3/	Nonfatal injuries: Total nonfatal	Rate per million man-hours: Killed	Rate per million man-hours: Injured
Oklahoma.....	385	516	901	-	-	2	32	34	-	19.87
Oregon.....	261	255	516	-	-	4	55	59	-	81.04
Pennsylvania..	4,785	8,259	13,044	3	1	15	729	745	.12	30.19
Rhode Island..	96	101	197	-	-	-	25	25	-	82.35
South Carolina	270	193	463	1	-	-	90	90	1.03	92.55
South Dakota..	324	221	545	-	-	-	32	32	-	46.12
Tennessee.....	1,315	1,651	2,966	-	-	6	348	354	-	59.93
Texas.....	442	1,507	1,949	4	-	4	74	78	1.07	20.91
Utah.....	79	161	240	-	-	-	33	33	-	75.16
Vermont.....	1,365	1,171	2,536	3	1	5	270	276	.61	56.19
Virginia.....	1,646	1,670	3,316	2	2	14	347	363	.31	57.03
Washington....	584	614	1,198	-	-	1	119	120	-	51.13
West Virginia.	868	821	1,689	1	-	4	76	80	.31	24.46
Wisconsin.....	820	582	1,402	1	1	2	174	177	.45	79.18
Wyoming.....	109	134	243	-	-	2	27	29	-	68.85
Other States 4/	122	266	388	1	-	-	23	23	1.22	28.14
Total, 1939	34,100	45,349	79,449	43	8	141	5,055	5,204	.33	36.18
Total, 1938	33,344	44,153	77,497	82	5	153	4,869	5,027	.61	37.58

1/ Permanent total disability: Loss of both legs or arms, 1 leg and 1 arm, total loss of eyesight, paralysis, or other condition permanently incapacitating workman from doing any work of a gainful occupation.

2/ Permanent partial disability: Loss of 1 foot, leg, hand, or eye, 1 or more fingers, 1 or more toes, any dislocation where ligaments are severed, or any other injury known in surgery to be permanent partial disability.

3/ Disability for more than remainder of day of accident.

4/ Includes Delaware, Louisiana, Mississippi, Nevada, and New Mexico.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

TABLE 17. - Employment and accident data for the quarrying and related industries in the United States, 1926-39, inclusive

Year	Men employed	Man-hours of employment	Killed	Injured	Rate per million man-hours	
					Killed	Injured 1/
1926	91,146	230,464,089	154	13,201	0.67	57.28
1927	91,517	229,805,889	135	13,459	.59	58.57
1928	89,667	224,953,034	119	10,568	.53	46.98
1929	85,561	211,765,529	126	9,810	.59	46.32
1930	80,633	186,502,184	105	7,417	.56	39.77
1931	69,200	133,750,124	61	5,427	.46	40.58
1932	56,866	93,709,860	32	3,574	.34	38.14
1933	61,927	87,883,263	59	3,637	.67	41.38
1934	64,331	95,258,380	60	3,924	.63	41.19
1935	73,005	110,033,341	51	4,152	.46	37.73
1936	80,022	147,064,448	91	5,717	.62	38.87
1937	84,094	158,298,530	77	6,348	.49	40.10
1938	77,497	133,766,111	82	5,027	.61	37.58
1939	79,449	143,846,583	48	5,204	.33	36.18

1/ Injury rates for years previous to 1916 are believed not to be representative owing to probable incompleteness of reports of slight or minor injuries.

Table 18 indicates that in 1939 cement-rock quarries and their related plants employed more than one-third of those occupied in work in "quarries and their related plants," there having been 3,796 engaged in the cement-rock quarries and 22,249 in the plants. Limestone quarries and related plants, with 22,968, ranked second in number employed. The fatal-accident rate for all types of quarries and their related plants was 0.33 per million man-hours of exposure; the marble producers with 3,697 employed, had no fatalities; and the 3,113 working in sandstone also avoided fatalities in 193 Cement-rock quarries and related plants had much the lowest fatality rate of the larger producers in 1939, 0.23 per million man-hours, with limestone next the granite and slate industries had identical fatal-accident rates - 0.56 per million man-hours of exposure - and trap-rock quarry operations had the worst fatality rate, 0.95. The cement properties had by far the lowest nonfatal-injury rate in 1939, 8.79 per million man-hours, against an average for the industry of 36.18; granite was second, with a rate of 42.42, and lime stone third.

Generated on 2024-09-19 09:54 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 09:56 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE 18. - Employment and accidents at quarries and related plants, by kinds of quarries, during 1939

Kind of quarry	Men employed - At quarry	Men employed - At outside works	Men employed - Total	Killed	Nonfatal injuries: Permanent total disability 1/	Nonfatal injuries: Permanent partial disability 2/	Nonfatal injuries: Temporary 3/	Nonfatal injuries: Total nonfatal	Rate per million man-hours: Killed	Rate per million man-hours: Injured
Cement rock.....	3,796	22,249	26,045	12	-	36	421	457	0.23	8.79
Granite.....	4,934	3,456	8,390	8	3	11	593	607	.56	42.42
Limestone 4/.....	14,947	8,021	22,968	14	5	50	1,688	1,743	.39	48.77
Limestone (chief product, lime)	3,828	5,804	9,632	7	-	13	991	1,004	.34	49.25
Marble.....	1,389	2,308	3,697	-	-	12	417	429	-	60.91
Sandstone.....	2,221	892	3,113	-	-	4	309	313	-	65.31
Slate.....	1,143	1,690	2,833	3	-	6	370	376	.56	70.42
Trap rock.....	1,842	929	2,771	4	-	9	266	275	.95	65.00
Total, 1939.....	34,100	45,349	79,449	48	8	141	5,055	5,204	.33	36.18
Total, 1938.....	33,344	44,153	77,497	82	5	153	4,869	5,027	.61	37.58

1/ Permanent total disability: Loss of both legs or arms, 1 leg and 1 arm, total loss of eyesight, paralysis, or other condition permanently incapacitating workman from doing any work of a gainful occupation.

2/ Permanent partial disability: Loss of 1 foot, leg, hand, or eye, 1 or more fingers, 1 or more toes, any dislocation where ligaments are severed, or any other injury known in surgery to be permanent partial disability.

3/ Disability for more than remainder of day of accident.

4/ Includes all limestone quarries and mills except those whose product was used chiefly for the manufacture of cement or lime.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

COMPARISON OF ACCIDENT OCCURRENCE IN ALL TYPES OF MINING ACTIVITIES

Frequently questions arise as to the relative safety or possibly the relative occurrence of accidents, fatal as well as nonfatal, in the various divisions of the mining industry. Table 19, taken from Bulletin 428 of the Bureau of Mines, gives the latest available complete data on accident occurrence in the mineral industries on a fairly comparable basis. It will be seen that in 1937 bituminous-coal mining had the highest fatality rate, 1.77 persons killed per million man-hours; anthracit mining was second, with a rate of 1.58; and gold, silver, and miscellaneous metal mines were third, with a rate of 1.08. Anthracite mining had the poorest nonfatal-injury rate, 113.58 per million man-hours of exposure; copper mining was second wit a rate of 94.99, and gold, silver, and miscellaneous metal mining was third with a rate of 93.90. The composite fatality rate of different branches of the mineral industries was 1.27 persons killed per million man-hours of exposure, and the composite nonfatal injury rate was 69.85.

TABLE 19. - Accident data, including rates for different branches of mineral industries 1937

Industry	Men employed	Man-hours	Killed	Injured	Number killed or injured per million man hours: Killed	Injured
1. Coal mines	589,856	811,422,146	1,413	68,277	1.74	84.1
Bituminous	490,771	675,568,195	1,198	52,847	1.77	78.2
Anthracite	99,085	135,853,951	215	15,430	1.58	113.5
2. All metal mines	118,429	239,544,432	219	18,055	.91	75.3
Copper	21,175	51,982,104	49	4,938	.94	94.9
Gold, silver, and miscellaneous metal	55,814	106,403,208	115	9,991	1.08	93.9
Iron	22,957	45,914,195	33	1,383	.72	30.1
Lead and zinc (Mississippi Valley)	8,466	14,708,722	9	756	.61	51.4
Nonmetallic mineral	10,017	20,536,203	13	987	.63	48.0
3. All quarries	84,094	158,298,530	77	6,348	.49	40.1
Cement rock	27,215	56,108,639	23	660	.41	11.8
Granite	8,961	16,082,747	7	862	.44	53.6
Limestone	24,789	40,719,626	23	2,173	.56	53.4
Limestone (chief product lime)	10,360	22,485,915	10	1,219	.44	54.2
Marble	3,647	6,873,690	—	350	—	50.9
Sandstone	3,242	5,511,121	4	411	.73	74.6
Slate	3,074	6,042,334	6	338	.99	55.9
Traprock	2,806	4,474,458	4	335	.89	74.9
In and about quarry	36,879	63,283,400	47	3,930	.74	62.1
In outside works	47,215	95,015,130	30	2,418	.32	25.4
4. Metallurgical plants	47,530	117,551,329	41	3,217	.35	27.4
Ore-dressing plants	14,497	32,331,042	14	1,119	.43	34.6
Smelters	17,957	46,094,524	13	1,040	.28	22.6
Auxiliary works	15,076	39,125,763	14	1,058	.36	27.0
5. All coke ovens	20,042	54,444,978	9	587	.17	10.8
Beehive	2,192	3,278,705	1	158	.30	48.2
Byproduct	17,850	51,166,273	8	429	.16	8.4
Total	859,951	1,381,261,415	1,759	96,484	1.27	69.8

Generated on 2024-09-19 09:56 GMT / https://hdl.handle.net/2027/osu.32435030643936
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY